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MOUNTAIN SOCIETIES RESEARCH CENTRE

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BACKGROUND PAPER NO. 1, SEPTEMBER 2011

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This paper was produced by the above-listed authors and commissioned by the University of Central Asia, Mountain Societies Research Centre. The authors alone are responsible for the contents

Acknowledgements

We would like to thank Emanuele Costa and Kishvar Pallaev from the Knowledge Management team at the University of Central Asia and Lailo Shogunbekova, Jyldyz Shigaeva, Maqsad Suriev and Alim Saileybaev for their excellent work on the references used in this report. We also thank Sarah Robinson, Cara Kerven and Roy Behnke for their contributions to the report. Thank you also to Nisar Keshvani and Mikhail Romanyuk for their design support.

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Pastoralism and Farming in Central Asia's Mountains: A Research Review

The Mountain Societies Research Centre (MSRC) was established in June 2011 as a university-wide centre within the University of Central Asia. The goal of the MSRC is to support and enhance the resilience and quality of life of mountain societies through sound research on the sustainable development and management of their physical, social, economic and cultural assets. The Centre aims to achieve this goal through the following objectives: 1) Generate and disseminate relevant knowledge through sound research; 2) Build Central Asian capacity to conduct research relevant to mountain societies; 3) Inform the policy and practice of sustainable mountain development through evidence-based research; 4) Serve as a knowledge hub in Central Asia for scholars, development practitioners and policymakers.

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Citation of this electronic publication should be made in the following manner:
Kerven, C., B. Steimann, L. Ashley, C. Dear, I. Rahim. "Pastoralism and Farming in Central Asia's Mountains: A Research Review." MSRC Background Paper No. 1. September 2011.
http://www.ucentralasia.org/downloads/pastoralism_and_farming_in_central_asia_mountains

The Mountain Societies Research Centre Background Paper Series is published electronically by the University of Central Asia

Preface

Societies living in mountainous areas of Central Asia face sometimes unique development challenges. Remoteness, and the accompanying underdeveloped infrastructure, lack of health and education services, and restricted access to markets, underlie these challenges. Extreme elevations, dramatic seasonal differences, and steep slopes limit options for natural resource-dependent livelihoods. Geography-specific challenges are compounded by the political and economic conditions of the region, including the still transitioning economies of the post-Soviet Central Asian states.

There is a lack of up-to-date, empirical, rigorously investigated and adequately documented scientific knowledge regarding the particular challenges of Central Asian mountain societies. The quality of research institutions across the region has eroded throughout much of the transition period. Research by international scholars has often been limited to donor project requirements. Independent, applied research is hampered by the absence of reliable data, a limited pool of researchers, and insufficient resources invested in independent and/or public research institutions.

In this context, the goal of this inaugural background paper of the University of Central Asia's Mountain Societies Research Centre is to investigate the state of knowledge regarding the most prominent livelihood in Central Asia's mountains—agro-pastoralism—and to suggest a research agenda to advance knowledge and its application to policy, programmes, and projects. A primary finding of the paper is that policy, programmes and projects regarding Central Asian agro-pastoralism, in mountain areas and elsewhere, have been driven more by accepted but unproven orthodoxies about:

- the extent and causes of land degradation;
- the need for decentralization; and,
- the need for privatization.

The first of these orthodoxies has not been adequately investigated in the Central Asian region. Empirical determinations of whether, where, how, and why degradation is occurring are required to identify measures for addressing land degradation. The second two orthodoxies regarding institutional change rest on questionable assumptions about the distribution of power and assets in Central Asian mountain societies. Instances from other parts of the world suggest that decentralization and land privatization may have unintended and undesirable effects. Detailed field research is also called for on the processes and effects of decentralizing the power to allocate and manage pasture resources from national and regional state authorities to local communities, as well as on the long-term effects of privatizing arable land and other means of production.

This paper was presented by Dr. Carol Kerven at the international symposium Pastoralism in Central Asia: Status, Challenges, and Opportunities in Mountain Areas in Bishkek, 13-14 June 2011. A diverse group of participants to the symposium—including scholars from the region and from further abroad, development practitioners, government officials, and others—commented on the paper through structured discussion groups. Their comments were accounted for in the final version of this paper and their specific recommendations are included in an annex.

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Introduction

This paper reviews and discusses the distinctive characteristics of mountain agro-pastoralism in Central Asia. Opening with a discussion of past and present research directions on this topic, the paper proceeds to outline the background to farming and raising livestock in the mountains. We then summarize key findings which are relevant to understanding where, how and why people practice agro-pastoralism in the mountains of Kazakhstan, Kyrgyzstan and Tajikistan. These sub-topics include the biophysical, agricultural, climatic, governance and socio-economic aspects of the material, social and political environments within which agro-pastoralism is carried out in these regions. We consider the limitations which have arisen in the last two decades, as well as noting fresh opportunities.

We conclude the paper by proposing that new research should critically assess several current orthodoxies – strong conventional beliefs - through conducting field-based studies. More empirical and long-term research will yield practical applications to improve conditions for Central Asian mountain agro-pastoralists and their environment.

These proposed research topics include:

- Inventorying the impact of the many pasture management interventions and messages from development programmes in Central Asia in the past 20 years.
- Identifying the scientific basis (if any) for these interventions and messages.
- Empirically measuring the multiple, interacting causes and feedback effects of land degradation, including changes in soil, vegetation, climate, and animal populations – both livestock and wildlife.
- Analyzing existing and new data on the social and economic effects of decentralizing the power to allocate and manage pastures to local communities; and of privatizing arable and pasture land and other means of production.

Old and new research directions

The emphasis of research has changed since the end of the Soviet period. Contemporary studies of agro-pastoralism in Central Asia have moved far away from the practical concerns of Soviet scientists. While we are now obliged to invoke ever-shifting development ideals and terminology, scientists in the USSR were looking long and hard at the ground. Directed by state planning committees, their obligation was to increase and stabilize production output, within a strict ideological parameter of development.

Ironically, much post-Soviet research on agricultural production systems is implicitly embedded in Western ideologies, activated through international funding channels that support research and development programmes, variously aimed at bolstering civil society, conservation, sustainable land management and market value chains. These directions have been very different from the previous Soviet-era biological production research emphasis such as selection, breeding and management of crops and livestock. These swings of emphasis mean there has been a neglect of basic biological research in favour of other methods and subjects which were never looked at by Soviet scientists in the context of agricultural production – interdisciplinary studies crossing the boundaries between natural and social science, and especially social science field studies of agro-pastoralists.

Ticks and Beetles – the rise and demise of Soviet research on agro-pastoralism

The production-oriented and practical research conducted on agro-pastoralism by scientists in the latter Soviet period is illustrated by two examples of small creatures that have a big impact on livestock production by agro-pastoralists in the mountains - ticks and beetles.

Box 1: Mountain Grazing, A Method for the Prophylaxis of Bovine Theileriasis

Following many years of field observations in the Kazakh SSR, recommendations for the prevention of bovine theileriasis are made. Transhumance to high pastures (where the vector ticks, *Hyalomma detritum* and *H. anatolicum*, do not survive) should take place no later than April 20 to 25 (before the tick season in lowland pastures). Acaricide treatment and chemoprophylaxis should be given before transhumance and provision should be made on high pastures for the treatment and isolation of cattle during the summer (Tutushin 1979)

Enjoined by the Communist central planning committees to find ways to deliver the livestock products required to feed and clothe Soviet citizens, researchers applied known and new technical methods to boosting agro-pastoral production. For example, from the 1940s, they laboured to develop new varieties of barley and sainfoin adapted to the short growing period of the high altitude Pamirs, publishing their results in scientific papers which now languish in the deserted Murghab high altitude Pamir research station, abandoned in the 1990s. Examples include:

Raikova 1936. Fodder base of animal husbandry of the Eastern Pamirs in the perspective of reorganising nomadic agriculture to settled. (Agriculture conference on the study of the Pamirs).

Raikova 1944. Improvement of Pastures of the Eastern Pamirs. Tajik Academy of Science, USSR.

Pekhachek M.I. 1946. Fodder value of the Eurotia Ceratoides of the Eastern Pamirs. "Reports of the All-Union Academy of agricultural sciences named after Lenin". 11-12, p.28-30.

There is a considerable body of documentation - formally published, in project reports, historical, cultural, biological, in Russian and English - that is relevant to understanding CA mountain agro-pastoralism. In this paper, we have not attempted to summarize Soviet-era research on this topic. Nor have we sought to cover all the variables that impinge upon the lives of mountain agro-pastoralists in Central Asia. Instead, we have narrowed the focus to some of the most critical components of mountain agro-pastoralism on which we have been able to locate reliable and current information in English (with only a few exceptions).

The geographic scope of the paper is limited to the mountain areas of Kazakhstan, Kyrgyzstan, and Tajikistan and the time frame is limited to literature produced in the past 20 years.

Box 2: Importance of Beetles in the Regulation of the Population of Pulmonary Nematodes in Sheep and Deer

The role of some beetles in decontamination of pastures from pulmonary *helminths Elaphostrongylus cervi, Cystocaulus ocreatus, Protostrongylus sp. and Dictyocaulus filaria* was described. Excrement of beetles belonging to the families *Scarabaeidae, Carabidae, Silphidae, Tenebrionidae, Histeridae and Staphylinidae* were collected from pastures of axis deer and Siberian stag in the Altai and Karatau, both Kazakh SSR, USSR. Coprophagous beetles play a significant role in removing faeces from pastures, thus limiting the possibility of mollusk infection, which in turn may reduce the infection of deer, sheep and other domestic animals (Tazieva and Shaltaeva 1985).

Characterising mountain agro-pastoralism

There are several dimensions wrapped in the category of Central Asian mountain agro-pastoralism. We consider each aspect separately, and then combine these aspects to arrive at a more general understanding of what we mean by this category.

Firstly, there are the mountains. Before detailing their extent and locations in Central Asia, we should outline their biophysical characteristics which influence human efforts to raise crops and livestock. Very simply, mountains – wherever they occur – offer incentives as well as barriers for people who depend on the land for their living. Mountains are attractive to farmers and pastoralists because they usually receive more precipitation than lower altitude plains and valleys. The natural vegetation of mountains is distinctive from surrounding lowlands, and therefore offers alternative nutritional values to animals. The slopes of mountains can be used to build gravity-fed irrigation channels to water crops. Springs and streams are available to provide water to people and livestock. The mountain climate is cooler in summer which means a more pleasant environment for people and for their livestock. Insect and microscopic species which are harmful to animals and crops will be different in the mountains. And in times of conflict, mountains offer a refuge and stronghold against enemies.

Figure 1: Mountain road between Tajikistan and Kyrgyzstan (Carol Kerven)

But there are also severe drawbacks to making a living on mountain land. The higher level of precipitation results in deep and long snowfalls in winter, which can cut off human communities for long periods. Some livestock species or breeds cannot forage under deep snow, and are not physiologically equipped to cope with long and intense cold periods. At the higher altitudes, the short frost-free period of between 88-101 days in summer results in a limited growing season for annual vegetation, affecting planted crops as well as natural pasture (Khukmatullo et al. 2005). Transport is impeded by steep and dangerous terrain, and routes may be blocked by avalanches and rock falls in winter and spring. Remoteness and inaccessibility can lead to social isolation and political marginalisation.

Transhumance

Given these attractions and disadvantages of mountains for humans trying to make a living, the obvious strategy, which has been pursued from prehistoric times, is to spend part of each year in the mountains when environmental conditions are optimal, and the rest of each year somewhere else – either in adjacent lower valleys but sometimes in very distant plains, or even in towns or cities. This pattern of seasonal movements up and down mountains is one of the forms of transhumance. Mountain or altitudinal transhumance is still widely practiced on every continent: in Europe, the Andes of Latin America, western rangelands of USA, Iran, Afghanistan, Turkey, north Africa, the Himalayas and Hindu Kush of Pakistan, India, Nepal and Bhutan, and in western China.

> *"Throughout human history, transfers of peoples and two-way cost-benefit exchanges between lowlands and highlands have persisted. These traditional forms of interaction have involved primarily contractually-shared access to renewable natural resources. The prime example is seasonal transfer of domestic animals from winter grazing at low elevations to high-altitude summer pastures. These transfers have involved many different forms: full nomadism, transhumance in many forms, and mixed farming…(Ives 2001: 41)*

Agro-pastoralism is a broad classification of agricultural activities undertaken by people, in which part or all of a household's livelihood is obtained from growing crops and/or raising livestock. There are degrees of households' reliance upon either crops or livestock, ranging from a minor contribution of household vegetable gardens to complete dependence on raising livestock. There are also functional interactions between households that grow feed crops to sell to other households for their livestock.

Central Asian mountain agro-pastoralism: An overview

Central Asian mountain agro-pastoralism (CA M A-P) shares the general characteristics of altitudinal transhumance which exists and is well-documented in other parts of the world. There are nevertheless, particularities of CA M A-P due to the history of the region – especially since the imposition of Soviet rule and radically altered production systems – and the particular environment - climate, geology, vegetation, soils, etc..

Many CA mountain households probably fall into the middle range of reliance on cropping and livestock, growing some grains, starches and vegetables as well as keeping modest flocks of animals. At the extreme ends of this range, there are households in the mountains which either own no animals and only grow potatoes or wheat, or only keep livestock and grow no crops at all. There are numerous intermediate situations. For example, in the Naryn area of central Kyrgyzstan, most households without their own animals are engaged in fodder crop production in order to sell it to their neighbours with livestock (Steimann 2011). In this area, households usually have their own fodder crop production, even those with large own herds.

The situation is very different in the high Pamirs of Tajikistan, where some households can only keep livestock, because crops either for humans or livestock cannot be grown due to insufficient frost-free days (Kassam 2009). Arable agriculture in the Tajik Pamirs is extremely limited by the terrain, altitude and precipitation, and occupies only 240 sq. km or 0.4% of the total area of Gorno Badakhshan (Breu and Hurni 2003). In the western and central mountain ranges of Tajikistan, such as the Zerafshan and Surkhob river valleys, villagers in the last two decades have urgently needed to obtain staple food crops of wheat and potatoes. This has resulted in fields carved out of steeply inclined mountain sides, leading to soil erosion and dangerous mud slides.

Figure 2: New fields on the mountain slopes in Surkhob valley, Tajikistan (Carol Kerven)

The position of CA mountain households on this livelihood continuum is dependent on socio-economic and agro-climatic factors which frame peoples' choices in the mountain regions. In this paper, we seek to characterise these factors, providing quantitative estimates where possible, to delineate the forces acting upon households' choices and constraints in pursuing agro-pastoralist activities.

Mountain agro-pastoralism in the economies and environments

Mountain agro-pastoralism is a productive and cultural system in the larger environment and economy of each Central Asian country and is referred to in this paper as the CA MAP niche. From a biological perspective, a niche is a rather restricted habitat but used here refers broadly to the specialised set of agro-pastoral activities that are found in the habitats of the CA mountains. Since mountain agro-pastoralism is a productive activity, it can also be viewed as an economic niche and significant contributor to GDP in Kyrgyzstan and Tajikistan, but much less so in Kazakhstan.

In Kyrgyzstan and Tajikistan, mountain agro-pastoralism occupies the largest area of land use, as discussed below, and denotes the comparative advantage of agro-pastoralism in an extensive mountainous land use setting.

> *"Kyrgyzstan and Tajikistan have a much smaller agricultural potential [compared to the three other Central Asian states] due to the high altitude of the majority of their territory. However, this sector is one of the few where they have export potential, as well as a vital area for food security" (Peyrouse 2009: 5).*

A World Bank review of Kyrgyzstan notes that the livestock sector "contributes substantially to the national economy by providing high value food, income, employment and foreign exchange" (2007:ix). Data on the agricultural sub-sector contribution to national GDP is very rarely disaggregated to separate livestock's contribution from crop agriculture, but in Tajikistan, livestock's contribution to GDP was estimated at 6%, which is undoubtedly an underestimate (Blench et al. 2003).

In Kazakhstan, Turkmenistan and Uzbekistan, pastoralism is mainly based in the steppes and deserts (Kerven et al. 1996), while mountain agro-pastoralism constitutes only a marginal economic activity, at the national level. In this review of the literature, very little published material was found that referred specifically to mountain agro-pastoralism in Kazakhstan. This is notwithstanding that the entire long eastern border of Kazakhstan with China is the Tien Shan and Altai mountainous region in which agro-pastoralism is practiced – but has simply not been reported on since the end of the Soviet Union.

Agro-pastoralism is however only one of several livelihood activities engaged in by Central Asian mountain peoples and is neither mutually exclusive nor incompatible with other non-agricultural income streams e.g. employment in government services such as local departments, teaching and health; trading; remittances; private sector employment as labourers or in shops (WFP 2005; Hangartner 2002). Thus a village schoolteacher in the mountains is very likely to have a few sheep and goats, a milking cow and maybe a small field of potatoes. Diversification also takes place within the agricultural sector, e.g. through paid farm labour or – quite important and of growing importance in central Kyrgyzstan and southern Kazakhstan (Steimann 2011; Kerven et al. 2008) herding for others in return for payment seasonally or year-round.

In the last two decades, mountain agro-pastoralists have sought to diversify their livelihood sources, as sole reliance on crops and/or livestock became less secure in the post-Soviet period. At the same time, new opportunities appeared for gaining income, in particular migration to work in Russia or Central Asian towns and remitting money back to agro-pastoral families in the mountain regions (Olimova and Olimov 2007; Schmidt and Sagynbekova 2008; Schoch et al. 2010;). Agro-pastoralism may no longer be a discrete occupation, as mountain inhabitants now combine multiple livelihood strands, which gives rise to investment by households both into and out of agro-pastoralism. Richer agro-pastoralists with bigger flocks are investing some of the money earned by their sons and daughters in town, into expanding their flocks and infrastructure such as barns, tractors etc. as well as opening up shops or starting transport services in the small mountain towns (Hangartner 2002; Kerven et al. 2008; Steimann 2011).

Mountain agro-pastoralists in CA sometimes also rely on government social support in the form of old-age pensions, child allowances, and other income support benefits. For example, the majority of households in two case study villages in Naryn, Kyrgyzstan was highly dependent upon government social support, even if the amounts paid are often small and not sufficient to make a living (Steimann 2011). In Tajikistan's mountainous regions, economic conditions from the end of the Soviet period until relatively recently meant that households had very little access to government social support (Hangartner 2002; WFP 2005).

The mountain biophysical environment and natural resources

We now consider what is particular about the Central Asian mountain bio-physical factors of geology, soil, topography, altitude etc. in which climate is an important factor. From the perspective of agro-pastoral production, the

mountains provide a contrast to the other Central Asian landscapes of steppes, valleys, deserts, and forests, all of which also contain pastoralists and agro-pastoralists (van Leeuwen et al. 1994; Kerven et al. 1996).

Figure 3: Map of Kazakhstan elevations in metres
(UNEP 2011)

At the brink of the current era after independence from the USSR, a baseline description of the mountains of Central Asia was based on a survey in 1975 carried out by the Soviet Union (Mamytov 1987). The survey was on the natural and agricultural resources of the mountainous regions, with a view to their further intensification in order to increase agricultural output. The mountain ranges surveyed were the Tien Shan in Kazakhstan, Pamir-Alay in Kyrgyzstan and Tajikistan, and Kopetdag in Turkmenistan (not considered in the current paper). The total mountain area was 41.4 million ha of which 39% was designated as pasture and 47% as agricultural land. Mountain forests were scarce, covering only 3% of the Central Asian land area.

The 1975 survey noted that under rainfed conditions, the biological productivity and thus the potential agricultural and pasture output was very low on the plains at the base of the mountains, highest in the foothills and at low and medium altitudes, and decreasing at the highest altitudes. However, under irrigation, the biological productivity of the plains rose dramatically.

> *"As a result of natural and historical conditions, the ecosystems of mountain regions differ sharply from those of the plains…In the foothills and at medium altitudes, dryland farming is developed. Wheat, barley and lucerne as well as some other fodder crops are grown there" (Mamytov 1987: 380).*

In the foothills and valleys at altitudes between 1,200 and 1,800 m.a.s.l., orchards of fruits (mainly apples, apricots, cherries) and nuts (pistachios, almonds and walnuts) were well-established in ancient times, and further developed in collective farms with varieties and cultivation methods researched by Soviet scientists. In the mountain regions, "Central Asia's fruit and nut forests are in some way unique. With over 130 species of trees and bushes, they are in effect natural botanical gardens" (Mamytov 1987: 382; see also Giuliani et al. 2011).

Natural pastures – that is, unimproved by planted species or methods – constitute the principal land area in the Central Asian mountain regions. Mountain pastures are by far the greatest source of livestock forage in

Kyrgyzstan and Tajikistan, but are relatively unimportant in Kazakhstan, with less than 5% of pastures in the mountain regions. Nevertheless, the absolute area of mountain pastures in Kazakhstan is considerable, being equal to that in neighbouring Kyrgyzstan and more than double the area of mountain pastures in Tajikistan.

Table 1. Mountain pasture area 1987 and percent in 2008 (Mamytov 1987; FAOStats 2011)

	Natural mountain pasture million sq km 1987	% mountain pasture of total pasture land 2008
Kazakhstan	82,600	5 %
Kyrgyzstan	88,200	94 %
Tajikistan	3,300	87 %

Figure 4: Map of Kyrgyzstan elevations in metres (UNEP 2011)

Kyrgyzstan's pastures cover an estimated 49 percent of the country, (93,650 sq km) or about 80% of agricultural land (Miller 2001). An additional 12 percent of the country is classified as forest land without forest cover, which means they are largely shrub lands utilized as grazing land. Most of the rangelands are located at altitudes between 1,000 and 3,500 m, in intermontane valleys and mountain slopes. About one-quarter of the country's rangelands are found at elevations greater than 3,500 meters.

Tajikistan's mountainous pastures are classified according to their season of use depending predominantly on their altitude (Sedik 2009). In the valley-upland transhumance system, "summer pastures are located from 2,200 to 3,400 meters above sea level and are used between June and August. Spring-Fall pastures are usually located between 900 and 1,500 meters above sea level and are used from March to May and September to November. Winter pastures are used between November and March and are located 500 to 1,200 meters above sea level. All year pastures are located at the same level as winter pastures but used all year round" (Sedik 2009: 9).

Figure 5: Map of Tajikistan elevations in metres (UNEP 2011)

The predominant vegetation types found in the mountains are desert, semi-desert and steppe on all the lower slopes and foothills and in some of the outlying ranges and major basins (Conservation International 2011). Patches of riverine woodland survive in the Ili valley in Kazakhstan, and a few other places. At higher altitudes, steppe communities, dominated by various species of grasses and herbs occur, while shrub communities are widespread in the lower steppe zone. Spruce forests, the only coniferous forest type, occur on the moist northern slopes of the Tien Shan, while open juniper or archa forest occurs widely between 900 and 2,800 m.a.s.l. (meters above sea level). Subalpine and alpine meadows occur in the western part of the mountains, from 2,000 to 4,000 m.a.s.l. and above. At the very highest and coldest elevations, there is limited vegetation cover and diversity, with cushion plants, snow-patch plants and tundra-like vegetation.

The majority of agricultural land in Kazakhstan, Kyrgyzstan and Tajikistan is semiarid or arid and cannot be used for crop cultivation without irrigation. Thus, while the share of agricultural land in the total land area differs a lot between Kazakhstan, Kyrgyzstan and Tajikistan, the respective share of permanent pasture in the agricultural land is relatively high in all three countries (compare Table 2). In Kazakhstan and Kyrgyzstan, nearly 90% of all agricultural land is considered pastures, while in Tajikistan the share is close to 70%. In the case of Kazakhstan, this has to do with the fact that much of the vast Kazakh plain is arid or semiarid and as such suitable for extensive pastoral production. By contrast, Kyrgyzstan and Tajikistan have large semiarid mountain areas where pastoral production prevails (Kerven 2006; Fitzherbert 2000).

Table 2. Land use by agricultural type

	Total Area [a] (sq km)	Agricultural Land [b] (% of total area)			Arable Land [b] (%of total area)			Permanent Pasture [c] 2002		
	2008	1992	2000	2007	1992	2000	2007	sq km	% of total area	% of agric. land
KAZ	2,699,700	82.0	76.6	77.0	13.0	8.0	8.4	1,851,000	69	89
KG	191,800	52.6	55.9	55.9	6.9	7.1	6.7	93,650	49	87
TAJ	139,960	32.1	32.7	32.7	6.1	5.6	5.1	31,980	23	69

ADB 2010:252; b) web.worldbank.org 2011; c) Kerven 2006: 3

Limits and possibilities afforded by the climate

The information here is derived from Russian Nature www.rusnature.info unless otherwise noted. The mountains of Central Asia receive more insolation (sunshine) than any other region in the former Soviet Union, but very little precipitation. Altitude and complexity of topography drive strong horizontal and vertical climatic variations across relatively short distances. Climatic conditions therefore differ according to slopes with different aspects, enclosed basins, and exposed plateaux.

The mountainous regions experience strong seasonal variations in temperature. Winters are relatively mild in the west and become more severe in the east, and also vary by altitude and exposure (height and aspect). In winter, the northern foothills located in Kazakhstan and northern Kyrgyzstan are affected by continental polar air masses, forming over Siberia and the plains of Kazakhstan. The temperature inversions mean that the foothills can be warmer than the surrounding plains. Kazakh pastoralists took advantage of this by over-wintering in sheltered valleys of the foothills, which were warmer than the wind-swept plains in winter (van Leeuwen et al. 1994). Protected sub-regions such as the Fergana valley (Kyrgyzstan, Tajikistan and Uzbekistan) and the Issyk-Kul depression in Kyrgyzstan have mild winters. Above 1,500 m.a.s.l., temperatures decrease with rising altitude. Above altitudes of 2,000 m.a.s.l. , winter temperatures are below zero C and in some enclosed valleys the mean January temperature can be below -15°C. In summer continental tropical air masses which form in the south and west over the Iranian plateau and the Turanian plain dominate, producing hot and dry weather in the low mountains.

Over the mountain regions of all three countries, precipitation varies from more than 1,500 mm in the Gissar Range of north western Tajikistan to less than 100 mm in the Eastern Pamir of Tajikistan (Conservation International 2011; Khukmatullo et al. 2005). Precipitation mostly arrives with the westerly flow originating in the Atlantic, which is however largely diminished by this inland point. Most precipitation occurs in March-April except in the eastern Pamir, which is affected by the Asian monsoon, when most precipitation occurs in summer (Breu and Hurni 2003). Much precipitation falls as snow in autumn, winter and spring. The snow melt running off mountains into spring rivers provides drinking water for humans and animals, and for irrigating crops, in environments which are otherwise often very dry.

The upper limit for growing crops likewise varies across the entire mountainous region, due to the differences in temperature and moisture resources at each location (Table 3). The upper boundary is on average 700-1,000 m lower in the Tien Shan mountains of south and eastern Kazakhstan and northern Kyrgyzstan, than in the Pamir-Alay ranges where it extends to 3,500-3,800 m.

Table 3. Altitude (m) of the upper boundary of cultivation of various crops in the Tien-Shan and Pamir-Alay mountains (source: www.rusnature.info)

Crop	Tien-Shan	Pamir-Alay
Cotton	850-1,000	1,000-2,000
Cereals (barley, wheat, oats)	2,800-3,000	3,000-3,500
Corn	1,200	1,900
Apples and apricots	1,800-2,000	2,500-2,800
Grapes	1,400	2,300

Arable farming is possible at the lower elevations due to plentiful sunshine and snow melt, but there is a shortage of land suitable for cultivation, due to the deeply incised valleys and steep slopes. In pre-Soviet times, mountain communities adapted to the physical constraints and opportunities by using agricultural practices, breeds and species of livestock and varieties of seeds which were suited to different altitudinal belts and the specific features of slopes. For example, in the large Chong Alay valley of southern Kyrgyzstan, livestock would be grazed on south-facing slopes in winter, where the sun warmed the soil and allowed earlier green-up of vegetation, while north-facing slopes which accumulated more snow in winter would be preferred for spring

and summer grazing as more winter moisture encouraged vegetation growth. Although steep slopes were extensively cultivated, soil erosion was limited in the pre-Soviet period:

> *"Traditional practices, such as terracing, attempts at afforestation of slopes, and planting trees along irrigation canals (aryk), helped to limit erosion and irreversible water loss. The key factor in maintaining sustainable agriculture was an ancient system of resource management which included a set of rules limiting land and water use, control over their implementation by elected representatives, and penalties for non-compliance. However, the situation was not entirely placid and competition for land between representatives of the state, landlords, religious organizations, and farmers resulted in both social and environmental conflicts. Probably the most serious environmental problem was that of deforestation." (http://www.rusnature.info/reg/16_1.htm)*

Although erosion had occurred before the 20th century, with the expansion and intensification of Soviet crop and livestock farms, erosion became much more severe in the mountains especially in the second half of the 20th century following major central planning decisions to intensify livestock output in the mountain regions (Mamytov 1987). The customary system of moving livestock seasonally between high-and low-altitude pastures also changed. Prior to the establishment of large-scale collective farms,

> *" ...private herds were relatively small and both routes and timing of migration were flexible and could be changed according to the availability of fodder and condition of pastures" (http://www.rusnature.info/reg/16_1.htm)*

State farms demanded much more rigid timetables and much larger herds to be shifted between pastures, with the result that pastures became overstocked and more degraded. There were many and complex changes over the 20th century in the policies and practices in the Soviet state farms, which are not discussed here. Some case studies are presented for Kazakhstan in Alimaev and Behnke (2008).

Biodiversity and wildlife in the mountains

According to one measure of biodiversity, the mountains of Central Asia are a biodiversity "hotspot" containing two major mountain ranges, the Pamir and the Tien Shan (Conservation International 2011). This hotspot's 860,000 square kilometers include southern Kazakhstan, most of Kyrgyzstan and Tajikistan, eastern Uzbekistan, western China, northeastern Afghanistan, and a small part of Turkmenistan (Encyclopedia 2008). This definition of a "biodiversity hotspot" is a biogeographic region characterized both by exceptional levels of plant endemism and by serious levels of habitat loss.

The mountains of Kazakhstan contain wildlife of economic value such as mountain goats, argali (big-horned) sheep, lynx and bears and other large predators, which are an important part of the biodiversity, and generate income (whether legal or illegal) from hunting or viewing (Schillhorn van Veen et al. 2006). In the mountain regions of all three countries being considered, there are many unresolved conflicts of purpose between and amongst mountain villagers, foreign and national wild life hunters, national wildlife conservation policies and international conservationists (Haslinger et al. 2007; Lüthi 2003; Undeland 2005). For example, mountain agro-pastoral inhabitants hunt the large mammals such as ibex goats and Marco Polo sheep as a food source, to provide meat and reduce their need to buy and consume livestock, while tour operators seek to exclude local people from the hunting reserves so they remain exclusively available for foreign hunters willing to pay high fees – e.g. USD 85,000 for a Marco Polo trophy license. According to Undeland (2005:37) in Kyrgyzstan "Hunting reserves cover 14.5 million hectares of land…and there are 80 private hunting tour companies …and 2 state ones (Society of Kyrgyz Hunters and Fishermen, and Military Society attached to the military units)". She cites a local pastoralist:

"Why should people from Bishkek and Germany come and hunt our animals? When we shepherd our animals through their territory, they stop us at the entrance to the gorge…. They check if we have any guns and only then give us a permission to go further. We are all very upset with this. We have to go through impassable mountains to get to the places where we can hunt without being stopped. Of course we understand that animals should be hunted wisely in a way that not to exterminate them all. But these foreigners don't do anything to preserve them either. If they pay us, villagers we would take care of these animals and they can come and hunt without any problems from us".

Figure 6: Kyrgyz family in the Pamirs, with Marco Polo wild sheep trophy (Carol Kerven)

There are also indigenous domesticated livestock breeds which are a valuable and endangered genetic resource, for example cashmere goats (Kerven et al. 2009), and indigenous fruit varieties, for example in the valleys of Gorno Badakhshan in the Tajikistan Pamirs (Giuliani et al. 2011).

Arable and pasture land: Case study of Kyrgyzstan

This section outlines the availability of arable land and pastures in the Kyrgyz Republic, explains the evolution and current status of the legal framework for their use, and highlights some of the most important aspects regarding the current, and often highly diverse, land use.

Arable land shortage

In Kyrgyzstan since the mid 1990s land has been distributed to individual households (Christensen and Pomfret 2007). The irrigated land per household varied between 0.5-3.0 hectares in three different villages based on the population and land ratio in the particular village. Also within a village there may be variation based on size of the extended family receiving parcel of lands on per head basis during land distribution. The kitchen gardens are more comparable in size between households, and varied from 0.2-0.6 hectares in three studied villages. A few households, because of their political influence, however had access to large swathes of rain-fed lands that may measure up to more than 50 hectares (Rahim et al. 2011). For the major proportion of households the limited available land for irrigated agriculture pre-

vents family farms from increasing their cultivation, while scarcity of winter fodder prevents them from expanding their animal husbandry (Eriksson 2006). On the other hand a sizable proportion of land has fallen out of cultivation due to the breakdown of irrigation and drainage systems, lack of essential inputs, machinery and financial resources (FAO 2006), and in some places due to shortage of working labour due to migration (Wolfgramm et al. 2010). By comparison, in the mountainous region of Gorno-Badakhshan, Tajikistan, despite improvement in agriculture and pastoralism, the tiny land areas available for cropping can hardly fulfill the subsistence requirement of a large number of families (Robinson 2005).

Arable land: Legal framework

By the mid-1990s already, most collective and state farms in Kyrgyzstan had been dissolved and their arable land distributed to the farm workers and their families in the form of 49-years land-use shares. In 1995, land-use rights were extended from 49 to 99 years, while a coherent federal Land Code, defining rules for mortgaging land and registering user rights, had still not been drawn up (Bloch et al. 1996, 15; Giovarelli 1998). In 1998, the Kyrgyz people voted in favour of private land ownership, and a constitutional amendment converted the former 49-year land-use rights into legal ownership documents. The Land Code 1999 secured these ownership rights, but still included a moratorium on land sales. In 2001, a presidential decree made private purchase and sale of land a reality, although several restrictions remained. Thus 78% of all arable land in the Republic passed into private hands until 2008 (Jones 2003:264; Spoor 2004:29; Lerman and Sedik 2009: 4). From the very beginning, every community had to set aside 25% of all arable land in a special Land Redistribution Fund (LRF). Since then, the LRF has been a land reserve fund at the level of the ayil okmotu (community), which is the lowest tier of the local government structure in the Kyrgyz Republic[1]. The communal administration has the right to lease out LRF land to individuals and groups through a public auction process, to use it for the expansion of rural settlements or to give it to those in need free of charge (Giovarelli 1998; Childress et al. 2003; Jones 2003). In addition, all rural households could keep their small home gardens (russ. ogorod) which they already owned during Soviet times and which retained their crucial role for the survival of the rural population (Ronsijn 2006).

Arable land: Access and use

In the early 1990s, crop and fodder yields collapsed in the Kyrgyzstan, not only due to the partitioning of arable land, but also because of a lack of cash investment, fertilizers and working machinery. Thus, by 1994, a large part of the rural population had to survive on their home gardens. Today, only about one quarter of all arable land is still in use for grain production (Mamytova and Mambetalieva 2008). Of this, about 60% is irrigated and 40% is rainfed. Most arable land is located either in the lowlands of the Ferghana valley in the south (mainly cotton, tobacco), or in the Chui valley in the north (mainly wheat, barley and maize) (Fitzherbert 2000; Mamytova and Mambetalieva 2008). In mountain areas, however, arable land is usually scarce and not irrigated. Thus, it is mainly used for fodder cultivation (lucerne, sainfoin, barley) or as hay land. Most rural households use their home gardens to cultivate potatoes and carrots for subsistence needs (Eriksson 2006; Ronsijn 2006).

There are various reasons why after 1991, many people have found farming extremely difficult. Most rural households have tried to make use of their private fields, but not all have succeeded. Repeated droughts since 2000 have badly hit households who mainly depend on rainfed or poorly irrigated land, so that they are no longer able or willing to take the financial risks involved. Many people still lack the necessary knowledge and skills, so that the lack of rotations and other sophisticated cultivation techniques has led to decreasing land productivity and diminishing yields. Yields of staples, vegetables and fodder are low and have fallen considerably since independence due to a combination of causes. Wheat production on irrigated has fallen from 3.5 and

1 In rural Kyrgyzstan, the term ayil okmotu is often used indiscriminately for the political entity (community, which usually consists of several ayils (villages)), the communal administration and the administration building, as well as for the head of the rural executive committee.

4 tonnes per hectare, to an average of 2.0 tonnes and even less per hectare, nearer to the previous average for rain-fed wheat (World Bank 2005).

Some households thus continue to struggle and try to improve their land use practices, while others have capitulated and turned away from crop cultivation. Instead, many rural households now increasingly focus on animal husbandry, considering it a more secure way of making a living. Consequently, observers have repeatedly questioned whether people's endowment with private arable land after 1991 has really been a blessing for everyone (Lerman and Sedik 2009; Bichsel et al. 2010; Steimann 2011).

Pastures

Covering 44% of the country's total land area and 86% of all agricultural land, pastures are much more abundant in the Kyrgyz Republic than arable land (see previous Table 2). They are usually categorized into winter, spring-autumn, and summer pastures, the latter accounting for the largest share (Table 4).

Table 4. Pasture resources in the Kyrgyz Republic (Fitzherbert 2000)

Type of pasture	Attitude	sq km	% of total land area
Summer pastures	2500 to 3500 m.a.s.l	38,890	19.4
Spring-Autumn pastures	1500 to 2500 m.a.s.l	26,970	13.5
Winter pastures	various	22,850	11.4
Total		88,710	44.3

Pastures: Legal framework

Unlike arable land, pastures have always been in state ownership, although consistent legislation was missing throughout the 1990s. The Land Code of 1999 was the first serious attempt to regulate pasture management nationally. The Code stipulated that each pasture category shall be put under a separate government authority, making the ayil okmotu (communal authorities) responsible for the allocation of winter pastures near to the village, the rayon (district) administration for the intermediate (spring and autumn) pastures, and the oblast (province) administration for the remote (summer) pastures (Giovarelli 1998; Childress et al. 2003; Undeland 2005). In 2002, the Regulations on the Procedure for Providing Pastures for Lease and Use' based pasture use on territorial leases, to be obtained by individuals or groups from the various levels of administration in a (mandatory) competitive bidding process. Pasture leases for grazing could be given for five years and could be extended by another 10 and again by a further 49 years (Undeland 2005; Liechti 2008). However, the lease system soon turned out to aggravate problems related to pasture management rather than to solve them. On the one hand, the rather static lease system seemed to fundamentally interfere with the flexibility inherent to pastoral behaviour. On the other hand, local herders were often unable and/or unwilling to cope with the complicated rules and procedures, or to pay for all the fees and documents required, while the local state administration usually lacked the necessary skills, knowledge and power to properly implement the law. In many places, this virtually resulted in open access to pastures (Ludi 2003; Liechti 2008; World Bank 2008; Steimann 2011). In summer 2009, the Kyrgyz parliament passed a new law 'On Pastures' to abandon the lease system and transfer all administrative authority over pastures to so-called grazing committees (Kyrg. jayït komitet) at the ayil okmotu level (Jacquesson 2010; see also the Section on 'Governance and Politics').

Pastures: Access and use

As a consequence of these constant changes, local practices of pasture use and access vary considerably. Due to the rayon and oblast authorities' weakness in enforcing existing rules, it has often been up to the communal authorities whether or not to enforce the legal procedure for pasture lease, which has resulted

in considerable disparities even between neighbouring communities. At the same time, wealth disparities between rural households (discussed in the Section on 'Income and Wealth') have a strong effect on how people access and use pastures. Alpine summer pastures are often far from the villages, access roads are in bad shape, and fuel is expensive, so that only the well-off can afford going there (Ludi 2003; Farrington 2005). At the same time, comparatively wealthy households can often afford to use formal rules and regulations when they come in handy to secure their livelihoods, i.e. by securing their exclusive access to a large pasture area through a lease contract. Similarly, the (usually expensive) construction of a barn on the winter or spring-autumn pastures has become an important means of gaining access to pastures in a situation where the pasture lease system has either been suppressed by the communal authorities or cannot guarantee secure and exclusive access to pasture resources (Steimann 2011).

Comparing the conditions in mountainous Kyrgyzstan with Tajikistan, Robinson et al. (2010) report similar dynamics for the Gorno-Badakhshan Autonomous Oblast (GBAO) in Tajikistan, where large herd owners increasingly tend to privatize remote seasonal pastures, while smaller owners lose access to these pastures and are eventually forced to overgraze other areas. Thus, it will be important to observe how local wealth – and, consequently, power – disparities shape pastoral behaviour in future, including the functioning of the communal grazing committees after the 2009 legal reforms (see also the Section on 'Governance and Politics').

> *"While in Soviet times land surveying (e.g. geobotanical and soil surveying) was dominated by a focus on agricultural production, the focus has now shifted towards SLM [sustainable land management] since the Central Asian countries have signed international conventions. SLM requires balancing ecological, economic and socio-cultural sustainability, and thus calls for inter- and transdisciplinary research approaches." (Wolfgramm et al.2010:244).*

Pasture degradation and livestock feed shortages

Pasture use in Central Asia has been based on livestock seasonal mobility that allows for re-growth of pasture plants (see sources cited in Kerven et al. 1996). Field research in south eastern Kazakhstan – including mountain grazing areas - has shown that reduction in mobility is detrimental to pastures in terms of quality and quantity of forage plants, and soil condition (Alimaev 2003; Kerven et al. 2006; 2008; Coughenour et al. 2008; Alimaev et al. 2008). Compared to pre-Soviet and Soviet times, livestock mobility has become restricted within rigid state borders in the post-Soviet period (Oram 2000). In addition to temporal movement by season, mobility also varies spatially as livestock are often still moved to different ecological zones. In the mountain pastures of Kazakhstan, Kyrgyzstan and Tajikistan there is vertical movement of livestock – transhumance – up and down slopes in different seasons between pastures around villages in the plain, foothills or valleys, to further distant and remote pastures, each at different elevations (Farrington 2005; Rahim and Maselli 2008; Ludi 2004; Robinson 2005). This vertical transhumance is in contrast to the mostly horizontal movement to different ecological zones in large parts of Kazakhstan's rangelands (Alimaev and Behnke 2008).

In Kyrgyzstan, the pastures further away from settlements have become under-utilized while the more accessible pasture areas are over-utilized. This is reported to lead to eco-system degradation mainly due to unregulated grazing (Ludi 2004; Undeland 2005). Richer households in eastern mountainous Kyrgyzstan who own more livestock move greater distances to reach preferred and less-used pastures (Farrington 2005). Efficient seasonal utilization of remote areas requires expensive private transport by truck or at least by car, using roads that have not been maintained for a long time (Kerven et al. 2008; Wirz 2009). In Tajikistan it has been reported that the pasture potential is sufficient to feed the actual number of dependent livestock, but the problem is with the uneven seasonal utilization over space (Sedik 2009; Vanselow 2011).

Figure 7: Hay harvesting, Naryn, Kyrgyzstan (Bernd Steimann)

Mineral mining is a strong contributor to pasture degradation in Kazakhstan (Karnieli et al. 2008). Burning of pastures is now a regular feature of the Kyrgyz autumn and fires sometime cover many square miles of mountain and foot hills, despite being forbidden under law (FAO 2006). The pastoralists assess the importance of forage plants on the basis of their availability during scarce seasons and not according to their land cover or watershed management potentials (Drees et al. 2010).

For several case study areas in Kyrgyzstan, pasture grazing pressure is particularly severe during winter and households are obliged to overcome the winter feed scarcity by continuous grazing around villages, storing feed, and destocking (Rahim et al. 2011). A study in the Wakhan mountain region of northern Afghanistan bordering Tajikistan noted that agro-pastoralists may anticipate feed shortages by increasing the quantity of feed stored or destocking, especially when fodder production competes with food production for families' subsistence (Kreutzmann 2003).

Figure 8: Stored hay in a mountain village, Zerafshan valley Tajikistan (Carol Kerven)

Cessation of concentrate imports from other republics has further worsened this winter feed scarcity (Fitzherbert 2000). Furthermore, an agricultural shift towards growing more grains and vegetables, which replaced fodder crops, has also contributed to the reduced availability of winter feed (Akramov and Omuraliev 2009). In Kyrgyzstan, the inefficient processing and storage of hay worsens the winter feed scarcity with regards to the quality of available fodder and inefficient storage, with estimates that this leads to a loss of energy and nutrients up to 40% (World Bank 2007).

In Tajikistan the seasonal migration patterns for livestock in the eastern Pamir are different from the western Pamir and north-west Tajikistan. The eastern Pamir is arid, and the high elevation pastures are not only utilized throughout the year for pasturing but the available shrubs are also uprooted for fuel (Breckle and Wucherer 2005). In eastern Pamir the households with large herds are more mobile than the small herds due to their ability to afford the cost and labour requirement for mobility, while the smaller herders are obliged to graze their livestock all year around settlements (Hangartner 2002). In the central and western valleys and mountains of Tajikistan there is some cropping in addition to pastoralism, such that livestock can partly depend on crop residues and by-product feed, and animals are taken to high pastures only during summer times by hired shepherds. Another pattern is transhumant livestock herding with no cropping (Herbers and Nuppenau 2006).

Figure 9: Hired shepherds in summer pastures, Surkhob valley Tajikistan (Carol Kerven)

Some reports suggest that in mountainous parts of Kyrgyzstan and Tajikistan, labour migration has led to abandonment of cropland (Wolfgramm et al. 2010) with consequent effects on the availability of fodder crops, residues and hay stored for winter. Fodder is traded by villagers in plains regions selling their surplus crop residues and hay to the mountain regions which have a deficit. According to some analysts (e.g. Sedik 2009), in the absence of an effective policy for resource management, the current livestock production system may lead to a vicious cycle of ever-lower animal yields and rural incomes. This line of analysis states that livestock farmers always desire to increase their production by adding animals, leading to a further deterioration in the feed per animal ratio and a further fall in animal yields.

Pasture degradation - its definition, causes, effects, extent and amelioration - was a hotly debated topic at the Symposium on “Pastoralism in Central Asia: Status, Challenges, and Opportunities in Mountain Areas” held in Bishkek in June 2011. The symposium organizers arranged for each sub-topic in this Background paper to be discussed in a series of small groups at the conclusion of the Symposium (see Annex I). Symposium participants were asked to sign up to join individual discussion groups. Initially 37 people signed up to be in the degradation group, 25 for climate change, 10 for incomes, and 5 for livestock while only 2 signed up for the gender

group. Since the degradation discussion group attracted the largest number of participants, clearly the concept of "pasture degradation" has assumed major significance for those concerned with pastoralism in Central Asia, as confirmed in the concluding section of this paper. Annex I presents a summary of the research priorities proposed in the small group discussion on pasture degradation, while some points made by the group are addressed here.

The group discussing pasture degradation recommended that the following types of data and research should have been included in this paper. The group's recommendations are shown in italics, with a brief comment in response.

1. *The extent, nature(types) and geographical distribution of rangeland degradation*
   Comment: This data is not available for the Central Asian countries since the end of the USSR, because rangeland degradation has not been systematically researched in the field since then. Reports since the early 1990s reproduce earlier maps and data from the Soviet period, when livestock management practices, locations and populations were entirely different than in the present day.

2. *Previous measures to mitigate pasture degradation*
   Comment: These would likely fall into several categories: a) measures applied in the Soviet period on Central Asian rangelands (b) measures applied in the last two decades, in the post-Soviet period and (c) measures applied in other rangeland regions of the world. Once the current causes of pasture degradation have been scientifically verified, then it may be appropriate to apply proven measures for mitigation, since preventative measures must be based on known causes. However, at present there is an absence of wide-scale and reliable data on the causes of degradation in Central Asian pastures.

3. *History and mechanism of pasture degradation*
   Comment: During the last decades of the Soviet period, there were many detailed empirical studies of pasture condition in the rangelands of Central Asia (Kerven et al. 1996). Some of these studies concluded that degradation and desertification were occurring, due to the livestock management systems imposed by the state and collective farms. Since that time, there have been almost no long-term field studies conducted on pasture condition. One of the main reasons for the dearth of contemporary pasture studies is the drying up of government funding to Central Asian research institutes, which would have allowed them to continue pasture research. It may well be time to re-examine the historical material to look for lessons that can be applied in the current and future period.

4. *Russian literature should be used and referred to and several local [Central Asian] authors should [have been] included in the authorship of the paper*
   Comment: The authors of the Background paper agree with this assessment.

5. *Priorities for future studies on pastures:*
   Resources Inventory: mapping the resources, collecting data on productivity, measuring the seasonal demands of animals, studying pasture use patterns, determining the optimal stocking rate;
   Comment: Carrying out "resources inventory and studying pasture use patterns" would be a very expensive effort, requiring some years, the involvement of a number of different scientific disciplines, and considerable field data collection in well-designed surveys. This level of financial commitment and geographical scale requires national funding, not piece-meal externally-financed research projects.

   "Measuring the seasonal demands of animals" has already been done with great precision in the Soviet period and the physiology of the domestic animal species has not changed since then (refer to some of the Russian language sources cited in Kerven et al. 1996).

   Regarding "determining the optimal stocking rate", some contemporary rangeland scientists assert that under the climatically variable environmental conditions such as are found in Central Asian rangelands, there is no "optimal stocking rate", and that this is an outdated concept which is not worth seeking in the field (Briske et al. 2003; Campbell et al. 2006; Coughenour 2007; Coughenour et al. 2008).

The theories and applicable methods of assessing livestock stocking rates and effects of grazing on vegetation and total system ecology have undergone some rethinking in the past few years, reaching the annals of the world's most respected journals such as *Science* (Gillson and Hoffman 2007; Sneath 1998). There remain fundamental points of disagreement, as these and other recent articles remark on; for example, the critical review by Briske et al. (2003) on prevailing rangeland vegetation paradigms has been cited more than 100 times in other scholarly sources. The issues are neither straightforward from a research nor a policy standpoint, as pointed out very recently by the Nobel prize-winning scientist, Elinor Ostrom:

> *"Disturbances to key aspects of ecological systems, including biodiversity loss,* ***climate change****, pollution and* ***natural resource degradation****, have become a major concern to many policy analysts. Instead of learning from the study of biological complexity however, social scientists tend to recommend simple panaceas, particularly government or private ownership, as 'the' way to solve these problems. ...In contrast to these simple prescriptions, recent research efforts are now illustrating the diversity of institutions around the world related to environmental conservation. The complexity of working institutions, however, presents a challenge to scholars who equate scientific knowledge with relatively simple models that predict optimal performance if specific institutional arrangements are in place" (Ostrom and Cox 2010; 451 emphasis added).*

LIVESTOCK: Species, breeds, husbandry methods, production levels, outputs

In the early 1990s after the collapse of the USSR, a number of general studies were undertaken about the rapid development of a market economy for livestock in the newly-independent Central Asian nations (Suleimenov and Oram 2000; Kerven 2003). International financial institutions, mainly the World Bank and Asian Development Bank, commissioned studies on the impact of market restructuring being promoted by these institutions, including privatisation of the state-owned assets of factories for processing meat, wool, leather and dairy products. Studies were also required in preparation for making loans and grants to the agricultural and livestock sectors; for example ADB (1997) and Schillhorn van Veen et al. (2005) in Kazakhstan, and the World Bank Sheep Project in Kyrgyzstan. These studies provide a baseline for assessing the changes in the pastoral livestock sector during the early stages of transition from the command to the market economy in the 1990s. It is however usually difficult to disaggregate the data from these large-scale studies that are applicable only to mountain-based livestock production.

Figure 10: Taking goat kids indoors for the night, Pamirs Tajikistan (Carol Kerven)

The species composition of livestock herds and flocks has changed in the past 20 years (Table 5). At independence in 1991, Kyrgyzstan's mountains contained approximately two and half to three times the number of sheep as are now kept. On the other hand, the number of goats in private flocks has more than doubled. After the decline in cattle numbers in the mid 1990s, numbers recently are slightly more than in 1992. In Tajikistan, there has likewise been a great increase in the recorded number of goats, but unlike Kyrgyzstan, the numbers of sheep have risen slightly, again after a steep decline in the 1990s. Cattle figures are slightly higher, as in Kyrgyzstan. Since most of the livestock in Kazakhstan's pastures are kept in the steppe and desert, further details on species and breeds kept in the mountains are not currently available. Comparing a baseline of 1992 to the situation in 2009, the biggest increase has been in goat numbers. Some of the reasons for the popularity of goats are discussed in Kerven et al. 2009, and include greater prolificacy, lower cost and ease of management compared to sheep, which has made goats more attractive for poorer households to keep.

Table 5. Changes in the livestock populations Kyrgyzstan and Tajikistan 1992-2009 (FAOStats 2011).

	Kyrgyzstan Heads (thousand)			Tajikistan Heads (thousand)		
	1992	2009	% change	1992	2009	% change
Cattle	1190	1224	+13 %	1390	1800	+13 %
Sheep	9225	3606	- 256%	2484	2578	+30%
Goats	300	897	+ 290 %	870	1568	+180 %

Kyrgyzstan

During the later Soviet period, extensive sheep herding was organized based on traditional Kyrgyz transhumant grazing practices but with improvements to reduce risks of herd loss. "There was a strong emphasis on fine wool production, as the Kyrgyz SSR was charged with being the 'wool factory' for the USSR as a whole" (Undeland 2005:18). Centrally-planned production was organised to supply inputs to increase the national herd of sheep, for wool production which was processed into garments and distributed throughout the Union (see also Kerven et al. 1996). Kyrgyz livestock flock growth had always been constrained by the problem of supplying enough fodder for winter; this was overcome through massive state investments in growth of fodder crops, including importation from other Soviet states, for winter feeding of livestock, and providing mechanised transport by truck and train, of livestock to available winter pastures in Kazakhstan, from the northern regions of mountainous Kyrgyzstan to the plains of southern Kazakhstan. In extreme cases, even airplanes were used to transport sheep, in the event of winter blizzards icing over the pastures.

As pointed out by several researchers (for example, Schillhorn van Veen 1995; Fitzherbert 2000; Ludi 2004), until the latter period of Soviet investments in winter feed, mechanised transport and infrastructure, there was only grazing competition for pasture land in the winter refuge areas of lower valleys and plains, but even here was not severe. Mountain pastures were abundant in comparison to winter pasture areas. "The relative lack of winter fodder was the major factor which kept levels of livestock and usage of spring/fall and summer pastures fairly low.…There were not strong population pressures on pasture land…"(Undeland 2005: 19).

The consequences of poor livestock nutrition over winter are higher adult mortality, lower fertility and birth rates, and increased risk of disease. For mountain households who cannot afford to obtain sufficient quality and quantity of winter feed for their animals, this leads to a cycle of poverty, as their flocks and herds cannot grow due to low productivity.

> *"Soviet livestock practices quickly led to intensive use of all pasture resources. By the early 1960s permanent over-stocking had been established as the normal state of affairs at almost all locations in the seasonal grazing cycle, exceeding the natural carrying capacity of the mountains by between two and two and a half times…this intensive use led to degradation. [In Kyrgyzstan] by 1990 about 16 percent of the rangelands were severely degraded, with alpine grazing lands suffering the most" (Undeland 2005:20).*

Figure 11: Cow in backyard during winter, Alay mountain valley Kyrgyzstan (Carol Kerven)

Kyrgyzstan's mountain farming systems are dominated by sheep and goats, with fewer numbers of cows per farm, while some yaks and a very few camels are kept in the highest altitude southern Alay mountains. Nationally sheep numbers fell from 10 million in 1992 to 3 million by the late 1990s and have only risen slightly to 3.6 million by 2009 (Schillhorn van Veen 1995; FAOStats 2011). Goat numbers, on the other hand, have risen steadily to three times the early 1990s number, being preferred by poorer mountain farm families as more productive than sheep and easier to raise; local small sample studies find that official statements of goat numbers are much lower than the actual numbers (Kerven and Toigonbaev 2010). Cattle numbers have risen somewhat since the mid 1990s. Horses remain important as sources of transport in the rugged mountain terrain, and there were 362,400 horses in 2009.

Following the closure in the early 1990s of state supply chains for meat, demand in urban areas for mutton drove up meat prices, which prompted a strong incentive for mountain farmers to raise and sell meat breeds of sheep. Private traders began marketing live animals from pastoral areas, in response to urban demand. The bankruptcy and closure of state fodder supply channels meant a substantial decrease in fodder production. As a result, pastoralists switched from wool to meat breeds (Schillhorn 1995; Farrington 2005). Farmers and pastoralists shifted the type of sheep raised from the introduced fine-wool crossbreeds back to the indigenous fat-tail sheep, which are favoured by Kyrgyz for their meat (Schmidt 2001). There were two primary reasons for this shift. First, in the early 1990s demand for wool on the international market fell sharply, depressing prices. Secondly, with the 64 percent decrease in sheep numbers between 1989 and 1996, the price of mutton, a staple of the Kyrgyz diet, rose to above international market rate. According to Farrington (2005), local fat-tailed sheep were "Less dependent on fodder crops, winter sheds and truck transport for migration and with a higher market value", and "quickly became a better economic option for independent herders in Kyrgyzstan. Consequently, as a result of these economic developments, wool production in Kyrgyzstan fell by 66 percent…"

Figure 12: Hired worker shearing merino sheep, Naryn Kyrgyzstan (Bernd Steimann)

By the middle of the 2000s, however, international prices and demand for fine wool increased (World Bank 2007) After the international rise in wool prices, large-scale sheep herders are now returning to raising fine-wool white sheep as the demand for wool increases and richer mountain farmers with larger flocks were able to benefit from selling merino wool (GL CRSP 2005 and 2006).

Other breeds of sheep were raised and valued by Kyrgyz agro-pastoralists (van Gelder 2004). The Gissar, or Gissarskay fat-rumped sheep is capable of producing 2 lambing per year. While the wool is dark and coarse, with very little commercial value, the Gissar sheep produces an excellent carcass. The lambs can grow to about 70 kg in 9 months and produce a carcass of about 25 kg, plus a 6 kg fat rump. Van Gelder remarks that this local breed apparently originated in the Hissar (Gissar) valley in Tajikstan and is well known throughout Tajikstan, Uzbekistan and Kyrgyzstan. Several other Kyrgyz indigenous breeds are described in Dmitriev and Ernst (1989) and mentioned by Stammbach (2009).

Kyrgyzstan was known for developing the best dairy cattle for the mountainous environmental conditions of the Soviet Union (van Gelder 2004). There was sophisticated research by Soviet scientists on breeding. Holstein introductions proved incapable of coping with the environment, but the Swiss Brown made significant contributions to the local breed (Dmitriev and Ernst 1989). The local Alatoo breed was said to be able to produce 20-25 L of milk daily if fed adequately. Ten years ago there were about 20,000 yaks in Kyrgyzstan, in the high altitude Alay-Pamir mountains of Osh and Batken Oblasts (provinces).

Tajikistan

There is a strong seasonal dynamic noted in contemporary reports on the imbalance between available pasture in winter and summer, with reference to Tajikistan's mountain animal husbandry systems (Sedik 2009:19) This also applies to Kyrgyzstan. In these pasture-based livestock feeding systems:

> *"it is the winter feed requirement that presents the most difficult challenge. While animal feed demand is relatively constant throughout the year, gradually increasing as animals grow, the availability of pasture feed is nearly nil during the winter, limited in the spring and autumn and peaks in the summer months"... this leads to a "mismatch between pasture feed production and animal feed requirements by month. Winter feeding depends on the availability of cultivated feed (cut hay, silage, feed crops) and concentrates (grain, oilseed meal and wheatfeed) during the winter, spring and fall months. Though animals, fattened from summer feeding in alpine pastures, are able to store food in the form of fat, the winter feeding bottleneck is still the major limiting factor on livestock nutrition in Tajikistan".* See Figure 13 below.

The present-day shortage of supplementary winter feed for livestock in the mountains of Tajikistan has meant that villagers, now responsible for their own private livestock, have had to change from the former Soviet collective farm system to a new pattern of seasonal migration timetables for grazing. This is well-documented for the eastern Pamirs (Domeisen 2002; Hangartner 2002; Haslinger et al. 2007; Vanselow 2011) but is not well-established by research in the last decades in the other mountain-valley ecosystems of central and northwestern Tajikistan. Figure 13 below schematically represents the significant shifts in the amount of time sheep, goats, cattle and yaks spend in different pasture zones of the eastern Pamir (Gorno Badakhshan). Livestock are no longer moved to the highest pastures for summer grazing on the lush alpine meadows, due to the cost of transport and poor condition of roads, and spend longer in spring and autumn in the valleys and plains.

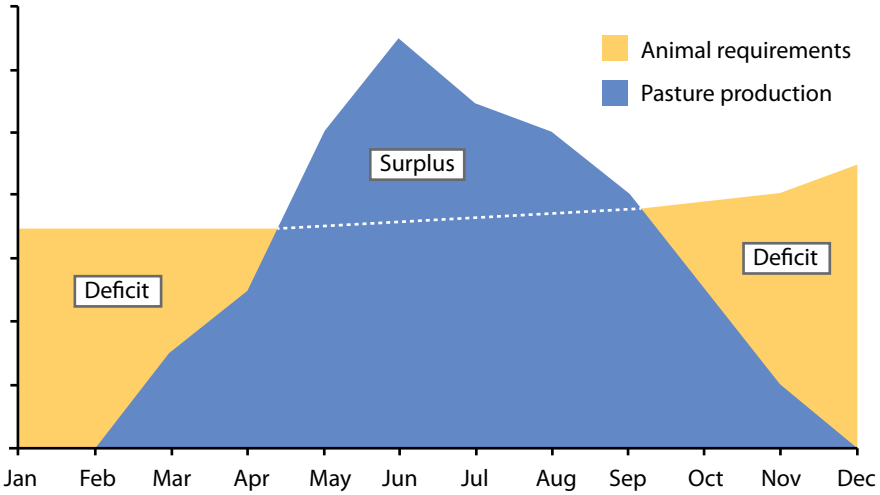

Figure 13: Seasonal mismatch between pasture supply and demand in Tajikistan (Source: Sedik 2009: 19).

Inevitably, this reduction in the quality of feed in winter and early spring will have had effects on the productivity of livestock. However, these effects are generally asserted in reports and have not been carefully measured in controlled experiments. Such experiments could be done by comparison with productivity data from the end of the Soviet collective farm period. Farmers and pastoralists need to know the costs versus benefits of improved feeding and nutrition for their livestock.

There were numerous new breeds of livestock developed by scientists in Tajikistan during the Soviet era, adapted to particular agro-ecological zones and intended to serve particular demands in the Soviet Union as a whole (Dmitriev and Ernst 1989). For example, the Soviet Mohair goat was developed in Sugd region of western Tajikistan and was introduced to the mountainous regions of eastern Tajikistan. Most of these specialized breeds have now been interbred with the indigenous breeds kept in the private flocks of the mountain agro-pastoralists.

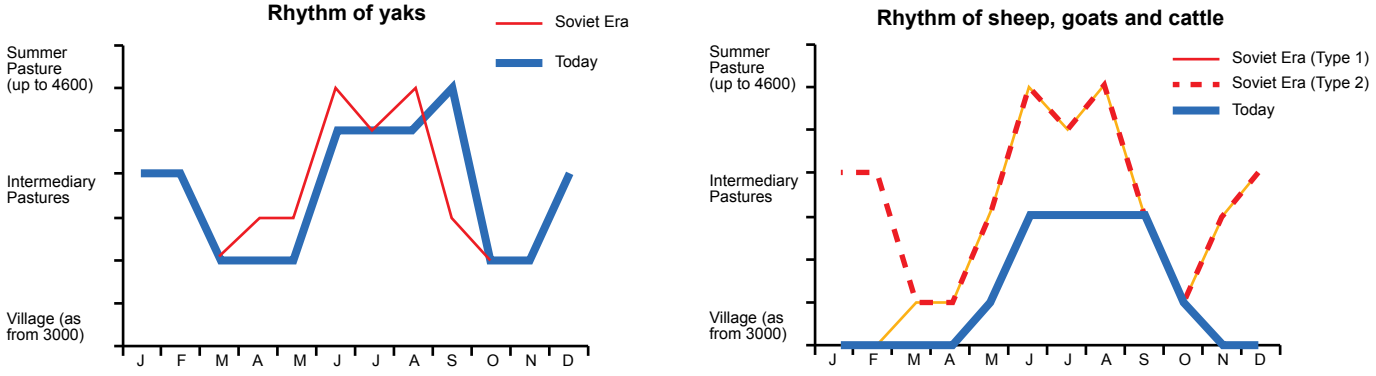

Figure 14. Seasonal patterns of pasture movement by livestock in the late Soviet era and by mid 2000s in Bartang valley, Gorno Badakhshan, Pamirs Tajikistan. (Source: Haslinger et al. 2007:162)

Incomes and diversification

In recent years there have been a growing number of household level studies which have improved the understanding of agro-pastoral livelihoods. In general, a large share of the rural population in the mountain areas of Kyrgyzstan, Kazakhstan and Tajikistan depends on (agro)pastoral production for their survival (Kerven et al. 2004; WFP 2005; Liechti 2008). Nevertheless, many rural households engaged in agro-pastoral production continuously fail to enter rural commodity markets and to develop their livelihoods beyond mere subsistence production. Although the possibility of using common pasture resources for private livestock production may be seen as a competitive advantage, research has identified several issues hampering the development of a solid value chain for livestock products, including remoteness, poor raw material quality, absence of disease controls, insufficient price information, and generally weak demand for certain products such as wool in the early post-Soviet period (Childress and Mogilevsky 2000; Kerven et al. 2002; Ajibekov 2005; Näscher 2009; Steimann 2011). In the case of Kyrgyzstan, this is underlined by the fact that a large share of rural households depend on state social welfare such as child allowances and old-age pensions, though of small amount. At the same time, studies in Kyrgyzstan find increasing social stratification and loss of mutual trust and aid among rural households (Kuehnast and Dudwick 2004; Farrington 2005; Sabates-Wheeler 2007; Steimann 2011). This creates a situation where most people prefer to work on their own and distance themselves from new forms of cooperation as rural producers increasingly abstain from cooperating over longer periods of time or with people outside their household and immediate kin.

Instead, many rural households have meanwhile begun to diversify their livelihoods. Although people would often prefer to make pastoral production more profitable by improving wool or milk production (Ilibezova et al. 2005, 34), in reality they usually diversify their incomes beyond agro-pastoral production and the agricultural sector. However, since there are very limited openings for jobs in the local public sector, opportunities for a self-employed business, or seasonal field and construction work, rural households increasingly diversify beyond the rural sector (Milner-Gulland et al. 2006; Shigaeva et al. 2007). In recent years, migration for labour has thus become one of the most important cash income sources for rural households, especially in Tajikistan and Kyrgyzstan (Olimova and Bosc 2003; Macours and Swinnen 2005; Jones et al. 2007; Schmidt and Sagynbekova 2008; Schoch 2008; Thieme 2008; Schoch et al. 2010).

Remittances sent back by migrants are often used to build up flocks and/or to compensate the lack of domestic workforce by hiring agricultural labourers (Olimova and Bosc 2003, 104; Schoch et al. 2010). For the time being, migration and animal husbandry thus seem not to conflict with each other, although the constant increase of livestock numbers may aggravate the pressure on pastures in the long run. An even more recent – and probably more precarious – form of complementing agro-pastoral production has been described by Steimann (2011; forthcoming), who shows how herders in a village in Central Kyrgyzstan have begun to work for a foreign mining company digging for gold and other precious metals on their community's spring and summer pastures. Although being fully aware that the extraction threatens the pasture resources and thus their prospects to practice pastoralism in the future, local herders nevertheless strive to work for the company which remunerates them far above local standards.

At the same time, rural societies are characterized by striking wealth disparities. Even in regions like Central Kyrgyzstan, where the overall importance of agro-pastoral production is high, many households must make a living without any livestock, while some of their wealthier neighbours own more than 1,000 sheep or 100 horses (Ilibezova et al. 2005; Steimann 2011). Although disparities already existed in Soviet times and the rise of absolute inequality after 1991 remains disputed (cf. Henderson et al. 2005; 2008), the collapse of state subsidies and the weakening of social welfare schemes have certainly added to the vulnerability of poor people towards shocks and crises of any sort. In addition, the increasing monetarization of everyday life has made it more difficult for the less wealthy to maintain their social relations with the better-off. This not only fosters social polarization, but also leads to new forms of dependencies between local households which must not be ignored when talking about local pasture management (Kuehnast and Dudwick 2004; Farrington 2005; Ilibezova et al. 2005; Shigaeva et al. 2007; Jacquesson 2010; Steimann 2011).

Gender

Numerous social, cultural, political and economic trends in Central Asia are altering gender roles and the division of labour in rural households, fields, pastures, and public services. The limited empirical literature suggests that these trends are increasing the role and responsibilities of women in the practice of agro-pastoralism without a similar increase in women's rights of access, ownership, and decision-making authority regarding agro-pastoral resources.

The collapse of the social support structure of the Soviet Union, including schooling, childcare, and health services, caused many women—who worked in these sectors more often than men—to lose not only these services, but also their jobs (ADB 2005) and the associated social position and status afforded by such jobs (Kuehnast 2002). The existence of these services previously enabled rural women to maintain a job and to raise oftentimes large families (Thieme 2008). The drastic reduction of services in the post-Soviet era had a similar effect on fertility rates. While fertility rates throughout the former Soviet Union initially dropped significantly (and continue to drop in Tajikistan), rates have been slowly increasing in Kyrgyzstan and Kazakhstan (World Bank 2011). In the mid to late 1990s, rural birth rates in the Central Asia states were, on average, one third higher than urban birth rates (Buckley 1998). Today the fertility rates in the Central Asian states are the highest of the former Soviet Union (World Bank 2011).

Simultaneously, the lack of economic opportunity in rural areas has led to massive labour migration to national urban centres and to international destinations, mainly southern Kazakhstan and Russia. While women do make up a significant portion of migrants, migration trends are increasing the number of female-headed households, increasing the burden of women to manage the household, farm, and pasture-related economic practices, and, in some cases, elevating the role of women in household decision-making (Thieme 2008) including decision-making relating to agro-pastoralism.

Figure 15: Pastoral women milking goats, Surkhob valley Tajikistan (Carol Kerven)

Recent studies have therefore increasingly scrutinized gender aspects of agro-pastoral production, both in terms of women's often difficult access to livestock and related resources (Undeland 2008), as well as their increased domestic workload when their husbands and sons migrate for labour (Kanji 2002; Schoch 2008; Thieme 2008).

The higher fertility rates in rural as compared to urban areas combined with the increased number of female-headed households as a result of migration contributes to what Agarwal (2010:64) terms the "feminisation of agriculture" in Central and South Asia.

Within Kyrgyzstan, the establishment of the Kyrgyz Land Code (1999), Law on Use and Management of Agricultural Land (2001), and Resolution #360 on Pasture Management and Use (2002) provided de jure equity for women with regard to access to pasture and agricultural land. As WESA (2005) found in a study in Chui Oblast and as was corroborated by Giovarelli's (2004a) interviews with women in every oblast in Kyrgyzstan, however, even when women did operationalize their legal access to land, economic barriers limited women's access to agricultural assets, inputs, and resources. Further, the reinvigorated and de facto prevalence of customary practices and customary law in independent Kyrgyzstan limits women's control of and role in political decision-making regarding agro-pastoral lands and resources. This is primarily because customary property rights, including animal and pastureland use rights, are attributed through male relatives (Giovarelli 2004a; Undeland 2008). Kanji (2002) similarly concludes that in post-Soviet Gorno-Badakhshan, Tajikistan, the intensification of women's workload—partly as a result of women's recent involvement in trading and other market-based economic activities compounding their household and farm-based responsibilities—and their increasing relative poverty have reduced women's participation in the political sphere, even at a local level.

Figure 16: Women spinning sheep wool, Chong Alay valley, Kyrgyzstan (Carol Kerven)

In the mountain villages, women are increasingly gaining some additional income by harvesting and selling animal fibres, mainly from goats, through new commercial channels mainly to China (Kerven et al. 2009). There have also been a number of NGOs which assist mountain pastoral women to sell their handmade animal fibre products, thus keeping alive ancient skills and creating new income opportunities.

Politics and governance

After the collapse of the Soviet Union, the role of the state in agrarian production has fundamentally changed, although at a different pace in the three countries discussed here. While the governments of Kyrgyzstan and Kazakhstan soon began to privatize the agrarian sector (Spoor 1999), agrarian reform in Tajikistan was seriously hampered by the civil war. However, land reforms in all three countries appear to have been particularly difficult for agro-pastoralists (Pomfret 2007, 21).

Kyrgyzstan

In Kyrgyzstan, the state has quickly withdrawn from direct support of the agrarian sector. In the course of a rapid privatization programme in the early 1990s, most collective and state farms were dissolved, and all livestock, machinery, built infrastructure, as well as most arable land was distributed to rural households, although

in an often untransparent and unequal manner. Only pastures remained in state ownership (cf. Abazov 1999; Spoor 1999; Kadyrkulov and Kalchayev 2000). Since then, several scholars have begun to critically examine the privatization process. One group of studies examined the role of the state administration and the former *kolkhoz* elite (cf. Giovarelli 1998; Alymulov and Kulatov 2003; Liechti 2008; Bichsel et al. 2010; Steimann 2011). They find that the rapid distribution of assets was often not transparent, and higher authorities had only little control over what was happening on the ground. This often led to the illicit appropriation of machinery and livestock by rural elites, and eventually contributed to the aggravation of local disparities in rural areas. Another group of studies mainly focused on the problems related to the new legal status of arable land and pastures (Bloch 1996; Giovarelli 1998; Jones 2003; Undeland 2005; Liechti 2008; Lerman and Sedik 2009; Steimann 2011). Concerning the latter, academics have repeatedly criticized the complicated pasture lease system (which was put in place in the early 2000s) for fostering the non-sustainable use of pastures and excluding the less wealthy from access to pastures.

More recently, researchers have begun to critically examine the 2009 pasture legislation reform, which abandoned the lease system and introduced pasture user committees (or grazing committees; kyrg. *jayït komitet*) at community level as the main decision-making body for pasture management. While Bolotbaeva (2009) highlights a number of legal shortcomings in the new law and warns that they may eventually lead to new uncertainties and conflicts, Jacquesson (2010) criticizes the idea of communal committees which rely on long-standing misconceptions of 'clan', 'custom' and 'tradition', but ignores the real, often unequal relations between local herders. Thus, the new approach would in principle reproduce earlier, unsuccessful attempts by the colonial and Soviet state authorities to regulate the use of pastures. In addition, Crewett (forthcoming) finds that the participation of local state representatives in these committees is often very formal, thus weakening the reform's original objective of strengthening participatory community-based governance structures (see also Biber-Klemm and Rass 2008; Omorbekov 2008; Sedik 2009).

Overall, the Kyrgyz state continues to exert considerable – yet often not well received – influence on local agro-pastoral production. This happens mainly through laws and regulations concerning the use of pastures rather than through direct involvement in production and marketing. It is important to note, however, that donors and INGOs play an important role too. Thus, the recent pasture law reform was a key component of the World Bank's Agricultural Investments and Services Project (AISP), with the cooperation of the Kyrgyz Government and other donors such as the Swiss Agency for Development and Cooperation. Furthermore, various foreign and national non-governmental organizations such as CAMP Ala-Too helped to test and implement the reforms at the local level (World Bank 2008).

Kazakhstan

Kazakhstan carried out comparable agrarian reforms but took a more gradualist approach towards decollectivization, which lasted from 1990 to 1998 (Spoor 1999; Alexander 2002; Kerven et al. 2004). According to Ospanov and Deberdeyev (1997, 57ff), the reform process was nevertheless highly formalistic and widely disregarded the peculiar needs of rural agricultural producers. Unlike in Kyrgyzstan, where most arable land was distributed in the form of private ownership rights to small farm households, in Kazakhstan nearly all arable land and all pastures remained in state ownership (Lerman et al. 2002). In some regions of the country, many of the former large *sovkhozes* were simply transferred into large collective or cooperative farms (Spoor 1999: 13f). Although often economically dysfunctional, many of them have lingered on due to the interests of the ex-Soviet rural elite which was hard for the central government to challenge. Behnke (2003: 83) thus notes that a "thorough 'destatisation' of agricultural land [was] followed by a very modest level of internal farm reorganisation". This may explain why today Kazakh "government policies (…) focus on the modernization of large farms, the profitability of extensive farming and improving distribution and quality" (Peyrouse 2009: 7), while private farms are usually small, with only few animals, and struggle with the loss of input subsidies (Robinson and Milner-Guland 2003). In terms of agro-pastoral production, the Kazakh state has remained the legal owner of all pastures, but meanwhile allows certain seasonal pastures to be privatized through leasehold by individuals. Usually, only the wealthy can afford to do so (Robinson et al. 2010: 5). At the same time, the

general retreat of the state from the agrarian sector led to the disintegration of infrastructure on remote pastures, including roads, barns, wells, and fencing. Several services ceased, which were formerly provided by the state to herders and their families living on remote pastures, such as schooling or transport facilities, which additionally discouraged seasonal migration for many (Kerven et al. 2008).

Figure 17: Improvised school bus for Kazakh villagers in the desert, who formerly migrated to mountains in summer (Carol Kerven)

Tajikistan

Agrarian reforms in Tajikistan were seriously hampered by the civil war which lasted from 1992 to 1997. This may be one reason why Tajikistan – unlike Kyrgyzstan and Kazakhstan – has maintained many elements of the Soviet agricultural system, so that the state still exerts considerable formal legal control over pastures (Peyrouse 2009; Sedik 2009; Rowe 2010). After 1991, the Tajik state only slowly embarked upon much-needed land reforms. Although the first legal acts were passed in 1992 already, it was only in 1995 only that the state allocated additional land to household plots (Giovarelli 2004b). At the same time, the state's attempt to reorganize the former collective and state farms into new corporate forms failed, so that after 1999, the focus was shifted to the model of so-called *deqhon* (peasant) farms. Nevertheless, the last 200 large state farms were not privatized before 2005, and even this undertaking seems to have been untransparent and rigged (Peyrouse 2009: 6). Today, there exists a large spectrum of farm types, from small family-based farms to mid-sized collective *deqhon* farms and large corporate farms (Lerman and Sedik 2008; 2009). Lerman and Sedik (2008, 59f) point out, however, that although small and mid-sized farms have meanwhile gained access to arable land and pastures, about 80% of all sown land is still held in large, unreformed farms mainly under state-controlled cotton production in the western lowlands, which are usually far less productive than smaller entities. In addition, the government has "retained a large role for administrative intervention in farm decision making" (ibid., 4). The Tajik state has done strikingly little to support production and marketing in other spheres such as the livestock sector, where farmers struggle with continuous winter fodder shortages (World Bank and Seco 2006).

Another widely raised critique is that the government has not followed through on land reforms. According to the 2004 Land Code, the Tajik state still owns all agricultural land, which includes both arable land and pastures. Individuals can obtain use rights to arable land and pastures through negotiation with the state administration at district level (Peyrouse 2009: 6). There are a number of tenure arrangements, ranging from lifelong inheritable use rights to lease arrangements for up to 20 years, but no possibility to sell or purchase land (Giovarelli 2004b: 7). However, the current legislation is very unclear about when and how pastures may be privatized or leased by individuals. This may not only lead to pasture fragmentation, but makes pasture access rights anything but secure (Ludi 2003; Robinson et al. 2010). According to Robinson and Whitton (2010:214), the main problem is that pasture resources are subject to a Land Code which was designed for arable land only. Similarly, Sedik (2009: 6) is critical that the current pasture management system does not acknowledge that

over 90 percent of animals are held in household farms, which lack the necessary resources for pasture upkeep. This has also to do with the fact that public institutions have hardly changed since 1991, but still operate according to central planning principles (World Bank and Seco 2006). Consequently, some critics suggest that Tajik pasture management should be reformed by adapting a model similar to the decentralized Kyrgyz pasture users' committees.

Climate change

Climate trends and projections

Climate change trends and projections in Central Asia have important implications for pastures, crops, and agro-pastoral livelihoods. Annual average temperatures are steadily rising in Central Asia and around the world (Christensen et al. 2007, Hansen et al. 2010). Warming in Kazakhstan, Kyrgyzstan, and Tajikistan has been similar to or greater than average global temperature rise (Aizen et al. 1997; Giese et al. 2007; Savitskaya 2010). The Intergovernmental Panel on Climate Change (IPCC) reports some increase in precipitation in Central Asia between 1900 and 2005 (Trenberth et al. 2007). However within the region, precipitation trends have varied, including a decrease in average precipitation (GoKZ 2009; GoTJ 2008; GoKR 2009; Savitskaya 2010). In mountainous Central Asia, often the most obvious sign of warming temperatures is the diminishing glacial extent. The glacier area of the Tien Shan is reported to have decreased by 25-35% during the twentieth century (Zemp et al. 2008) and by 32% between 1955 and 1999 in the northern Tien Shan (Bolch 2006).

Climate change projections for Central Asia have a level of uncertainty due to the regions' mid-continent location and complex topography (Christensen et al. 2007). Projections do, however, show temperature and precipitation trends across models and scenarios. Temperature projections for Central Asia include warming much greater than the global mean (3.7°C by 2100 compared to an 3°C globally), maximum warming in summer months, and a higher temperature increase at high elevation areas (Christensen et al. 2007). Precipitation projections for Central Asia are for overall drying with decreased spring and summer precipitation but increased mean winter precipitation (Christensen et al. 2007). Projections include a median change of –3% in the annual precipitation by 2100, with +4% in December, January, and February and –13% in June, July, and August; an increase in the frequency of very dry spring, summer, and autumn seasons; and more common occurrences of very high precipitation in winter (Christensen et al. 2007).

Throughout Asia, projections are for an increase in extreme weather events such as drought, heat waves, strong winds, and heavy precipitation (Cruz et al. 2007). In Central Asia, these weather events are expected to lead to desert expansion and increased flooding (Cruz et al. 2007). Mountain communities are particularly at risk from landslides, mudflows, floods, avalanche, and glacial lake outbursts. Increased precipitation intensity and increased run-off from rapid snow and glacial melt can saturate slopes and accelerate erosion, exacerbating these disasters (Chestin and Colloff 2008; Pollner et al. 2008).

Climate change impacts on pastures

Pasture productivity, hay fields, and fodder crops are strongly influenced by climate conditions. The 2007 IPCC report concludes with a high level of confidence that Central Asia is highly vulnerable (highest rating) to land degradation from climate change impacts (Cruz et al. 2007). The gradual reduction in summer rainfall and increased warming during the growing season is likely to cause reduced productivity in grasslands and increased bare ground (Zha et al. 2005). An increase in bare ground can lead to increased soil moisture evaporation resulting in more bare ground and a feedback process that accelerates grassland degradation (Milton et al. 1994). The UN Framework Convention on Climate Change (UNFCCC 2007) projects that grassland productivity will decline in the semi-arid and arid regions of Asia by as much as 40-90% for an increase in temperature of 2-3°C combined with reduced summer precipitation. Additional research from the Second National

Communications to the UN Framework Convention on Climate Change from Kazakhstan, Kyrgyzstan, and Tajikistan all conclude that drying associated with higher air temperatures could cause a significant reduction in the productivity of certain pastures (GoKZ 2009; GoTJ 2008; GoKR 2009). While warming temperatures will result in a longer growing season that may benefit certain plants and fodder crops, increased drying and precipitation variability (including drought) are likely to negatively affect pastures and rain-fed crops in particular (Tebaldi et al. 2006). Additionally, increased heavy rain on bare ground is likely to cause higher levels of soil loss due to the impact of raindrops on soil and the runoff water removing these soil particles.

Throughout Asia, the zone of cool temperate grassland which includes much of Central Asia, is projected to experience a decline in net primary productivity and a shift northward (Sukumar et al. 2003; Christensen et al. 2004; Tserendash et al. 2005). Decreased pasture productivity, heat stress, and reduced access to water could cause a reduction in livestock milk production and an increase in some diseases (Cruz et al. 2007). In addition to decrease productivity, some pasture species are also at risk of extinction. Projections under a doubled CO^2 scenario using two global climate models show that 105 to 1,522 plant species in Central Asia's neighbour China could become extinct (Malcolm et al. 2006).

While climate change projections for warmer and drier summers are significant for agriculture, climate variability and extreme events are equally or more important factors (Tebaldi et al. 2005; Lioubimtseva and Henebry 2009). Climate variability and extremes are characteristic of Central Asia, yet climate change is projected to increase both the variability and extremes. Drought, increased heavy precipitation events, increased winter precipitation and blizzards, heat waves, and high wind events can dramatically impact livestock productivity. Livestock production is particularly sensitive to drought and aridity is already a limiting factor in much of this region (Lioubimtseva and Henebry 2009). The drought-induced lack of pasture and fodder resources may lead to overgrazing, animal death, or force livestock owners to destock herds they are unable to feed, usually at low prices (Batima 2003). Rebuilding livestock numbers can take years, which increases livestock owners risk to future impacts. Pastures are more susceptible to overgrazing during drought often leading to pasture degradation (Geist and Lambin 2004). In Central Asia and Mongolia, severe winter conditions, know as dzud, lasting one or more months are responsible for significant livestock deaths. Warming winter temperatures do not appear to be alleviating this threat but rather exacerbating it through increased winds and more dramatic temperature fluctuations (Batima 2006).

Potential climate change impacts to pastures and livestock in Central Asia are summarized here, including negative and positive impacts.

Negative impacts on pastures and livestock

- *Altered water availability.* Pasture productivity is closely associated with water availability (Knapp and Smith 2001). Increased evapotranspiration combined with reduced summer precipitation is likely to lead to a drying of pastures and decreased pasture productivity (Laporte et al. 2002; Fay et al. 2003; Luscher et al. 2005). This drying could lead to changes in species composition (Luscher et al. 2005), decreased biomass, an increase in bare ground, and land degradation (Zha et al. 2005).

- *Drought.* Drought causes decreased pasture productivity and reduces the water sources livestock rely on (Geist and Lambin 2004). Decreased pasture productivity affects both warm season grazing and the hay production that most livestock owners depend on to feed animals through the winter.

- *Erosion from heavy rain, strong wind, and permafrost melt.* Heavy rain events, stronger wind, and melting permafrost can increase wind and water erosion in pastures, causing pasture degradation, landslides, and floods (Nearing et al. 2004; Smith and Lazo 2001; Sharkhuu 1998).

- *Increased winter precipitation.* Increased winter precipitation could potentially raise risks to livestock due to reduced grazing on pastures covered by snow for longer periods and snowstorms that threaten unsheltered animals with exposure (Batima 2006). Additionally, increased winter precipitation could delay spring plant growth and pasture entry and if winter precipitation melts, or falls as rain, and then freezes,

it creates ice sheets preventing animals from grazing as occurs in parts of Mongolia (Batima 2006) and throughout northern pastures of Central Asia.

- *Infectious disease.* Higher temperatures and milder winters could contribute to the spread of vector borne disease in livestock (Harvell et al. 2002). The spread of bluetongue disease from the tropics to mid-latitudes has been linked to warming temperatures (van Wuijckhuise et al. 2006). Increased disease spread among livestock can also contaminate humans.

- *Changes in plant communities.* Changes in climate (CO^2 levels, temperature, precipitation) will favour some species and discourage others leading to changes in native pasture plant composition and diversity (Gitay et al. 2001; Zavaleta et al. 2003; Christensen et al. 2004). While some of these changes may have a positive influence on grazing quality and biomass, changes in spatial and temporal vegetation patterns have important implications for grazing management (Christensen et al. 2004).

- *Heat stress.* Heat stress in livestock can cause decline in physical activity and associated declines in eating and grazing (Mader and Davis 2004). Heat stress can also limit milk production (Parsons et al. 2001) and reduce conception rates (Amundson et al. 2005).

Positive impacts on pastures and livestock

- *Longer growing season and decreased limitation from cold temperatures.* Pastures, hayfields, and fodder crops with sufficient water availability may experience increased productivity due to a longer growing season and the reduced impact of cold temperatures (Rustad et al. 2001).

- *CO^2 fertilization.* CO^2 fertilization is generally considered to be more important in tropical systems, however, higher levels of CO^2 may benefit trees and C3 grasses under certain conditions although these species will not benefit from warming (Fischlin et al 2007).

Clearly the wide range of likely climate change impacts to pastures and livestock have large social and economic implications for agro-pastoralists. While little empirical work in Central Asia has demonstrated the direct socio-economic impact of climate change, the impacts discussed above are likely to exacerbate social and economic challenges (Adger 2003).

Climate change adaptation for pastures

With adaptation measures, climate change impacts may be reduced or avoided. Research recommends improving pasture management through better grazing management and pasture water supply and strengthening animal bio-capacity through improved shelter, supplementary feeding, breeding, and veterinary services (Batima 2006). Access to weather and climate information, enhancing rural livelihoods, and improving food security have also been recommended as key for climate change adaptation (Batima 2006; Glantz et al. 2009). The 2007 IPCC report (Cruz et al. 2007:490) also recommends the following climate change adaptation measures for livestock production in Asia generally:

- Breed livestock for greater tolerance and productivity;
- Increase forage stocks for unfavourable time periods;
- Improve pasture and grazing management including improved grasslands and pastures;
- Improve management of stocking rates and rotation of pastures;
- Increase the quantity of forages used to graze animals;
- Plant native grassland species;
- Increase plant coverage per hectare; and
- Provide local specific support in supplementary feed and veterinary service.

Providing insurance facilities and disaster funds to assist pastoralists to cope with harsh climate events is another strategy (Linnerooth-Bayer and Mechler 2006).

Climate change adaptation efforts largely aim to decrease erosion and increase plant cover which is highly compatible with climate change mitigation efforts to sequester carbon (Glantz et al. 2009). Pastures can act as important carbon sinks and the relevant mitigation potential of pastures may be an opportunity for pastoralists in Central Asia to market the mitigation effect of their pasture management. While critical to reducing vulnerability to climate change, adaptation efforts are often challenged by ecological, social and cultural, information, financial, technological, and political constraints including limited access to climate change information, limited national capacity in climate monitoring and forecasting, risk perception and tolerance, lack of coordination in adaptation strategies, and cost of adaptation efforts (Adger et al. 2007).

Conclusions and Research Priorities

The objective of this overview paper has been to identify the Central Asian mountain societies' generalized niche with regard to agro-pastoralism, in order to propose initial research areas that will further promote understanding of this niche. Pinpointing research areas is a step-wise process requiring several phases. Firstly, we must compile and review what is already written about the subject of mountain agro-pastoralism in Kazakhstan, Kyrgyzstan and Tajikistan. This paper has endeavored to accomplish the first step, though the process is incomplete at this stage. One drawback is that the authors have mainly referred to works available in English, though recent research in Russian and the national languages may well be available.

The review so far brings to our notice the most prominent topics in terms of the attention received by previous research and development programmes. The next step is to determine whether there are controversial research findings or opinions about some of the topics. Are there divided views on the trends, data or conclusions of previous work? A parallel step is to ascertain which topics appear to be over-researched – too popular – while other topics have been neglected and therefore offer openings for original research. There are also inconclusive research findings that should prompt more research before definitive answers can be provided. And there are on-going research requirements – monitoring, checking, surveying, data collection – which while not always very exciting, are the fundamental building blocks for reliable long-term research programmes.

Over the past 20 years since the end of Soviet-era research, the most prominent topics covered by research on CA MAP are firstly, pasture management and mismanagement, and linked to this, land degradation. Many of the modern reports on these two topics in CA have been superficial, derivative and non-empirical, but have nevertheless been influential in attracting more donor funds to the same topic. Thus many projects and programmes have been designed for sustainable pasture management intended to ameliorate degradation. Much donor, UN and international NGO money has been spent on short-term research and projects on pasture land management. This brings us to our first conclusion, which is that research is needed to confront the "environmental orthodoxies", following Ives (2001):

Environmental Orthodoxies

> *"...a great amount of 'development policy' has often been driven by simplistic, and even scientifically unsupported, assumptions. [For example] the collection of environmental orthodoxies embedded in the 'Theory of Himalayan Environmental Degradation'. The sheer simplicity and intellectual attractiveness of this particular orthodoxy has ensured its survival despite its effective scholarly rejection (Ives 2001 pp. 132-144).*

'Desertification' is another term that has produced extensive agency and activist political mileage; regrettably, it has also been adopted in modified form as 'mountain desertification'. (ibid. p. 153)

Any examination of environmental orthodoxies, however, will require an assessment of why they have become so widely accepted and so persistent. This will require at least two specific avenues of enquiry. One would entail an investigation of how and why big agencies so often appear to prefer simple, even simplistic, solutions (panaceas) to solve perceived problems (Thompson et al., 1986; Griffin, 1989). The other avenue of enquiry would require a critical review of the way the environmental and popular press, including the news media at large, appear determined to propagate such orthodoxies, frequently to the detriment of both environment and people. And what can be done to arrest or reverse this situation?"

The promulgation of environmental orthodoxies suggests that there may be a political economy of the "degradation discourse" connected with the intertwined interests of researchers and governments, and the money, prestige and influence that flow between these. Such a discourse can create incentives for researchers to disseminate scare stories about the disastrous conditions of the land – and now the climate – that provide governments with justification to press for certain changes. At the same time, disseminating politically-worrying scare stories enables researchers to move up the research funding ladder, when government agencies set funding criteria. The degradation discourse about pastures and pastoralists in China has not been without political foundation and intention (see for example Harris 2010). One of the difficulties for researchers is to be ideologically neutral and still obtain funding.

In the last decades of Soviet central planning for agriculture, Central Asian pasture scientists steadily and insistently challenged the Soviet orthodoxy that humans could always conquer nature and thus relentlessly increase livestock production on the pastures (Kerven et al. 1996; Kerven 2003; Alimaev and Behnke 2008). Moreover, much of the feed for the ever-growing livestock numbers was grown on the irrigated semi-arid plains, causing another ecological disaster exemplified by the shrinking Aral Sea. The scientists pointed out the ecological ceilings which if surpassed, resulted in environmental damage and loss of economic productivity.

Soviet agricultural scientists also warned against greater development of irrigated fodder and food crops on the steep slopes of the mountains. Noting that "Soil and plant covers are closely inter-related….Thinning of grass stands and shrinking of forest cover in mountain territories contributes to erosion processes and leads to the emergence of gullies and mudflows….With the rapid development of livestock breeding, in particular sheep-breeding, pasture erosion is becoming an acute problem" (Mamytov 1987: 385). Since the 1990s, this early warning of the land degradation in the mountain pastures has expanded into a crescendo of concern by international donors and NGOs.

"Degradation" and "desertification" were the dominant characterizations of the pasture conditions throughout the rangelands, including the mountain pastures, in the Soviet scientific literature of the 1980s. This characterization was continued in the post-Soviet period, as Western-trained and funded researchers moved into the newly-opened Central Asian research space, and carried on looking for degradation. Of course, the entire mode of production had been terminally destroyed, while livestock numbers plummeted. The locus, causes and degree of pasture degradation were all radically altered as a consequence, while the ability of newly-unemployed pasture users – the agro-pastoralists – to invest in alternative management methods was severely limited. Nevertheless, large and small-scale donor projects have continued to attempt all kinds of pasture management schemes, convinced that they were needed to halt degradation and desertification, and improve pasture productivity. Conclusions about whether, where, how, and why degradation and desertification are occurring, and what methods could be used to tackle these processes, have been based less on current empirical evidence and more on untested orthodoxy. Nevertheless, to address a perceived degradation crisis, larger organizations like the Asian Development Bank, United Nations Development Programme, World Bank and USAID have allocated considerable funds to national offshoots, programmes, projects, committees, secretariats, publications, websites, maps, data bases, knowledge management, evaluations, and recommendations. For a selection of a few examples, see CACLIM 2008 and 2009; ABD 2008; CARNET; Ji 2008; PALM; UNDP 2007, 2008; WB 2003, 2007; UNEP 2011.

Research has sometimes been used as part (and often a small part) of donor-funded projects aimed at land use management that will meet political commitments for operationalizing international agendas, such as the United Nations Convention to Combat Desertification (UNCCD). Because research on land use is often funded through these very same projects, researchers have had little incentive to undertake objective data collection that might refute the assumptions of development agendas, nor have researchers been granted the funds to pursue open-ended long-term scientific investigations on pasture conditions and changing land use. As a consequence, there may be little objective, empirical basis for these projects.

The first research priority is to inventory the impact of the many pasture projects in the mountains. What was the uptake of the various pasture improvement methods demonstrated and advocated? Did mountain villagers who depend on the pastures apply these methods, and did the villagers obtain results that were useful to them? What were the results? Are the benefits replicable without external technical funds and assistance? Who benefitted? What were the costs? Who bore the costs?

An example of an assessment which found little impact is illustrated here. A five year World Bank and Global Environment Facility (GEF) project on dryland rangeland management in Kazakhstan was recently evaluated (World Bank 2010). At a combined cost (with co-financing) of some USD 10 million, the project directly benefited only 133 agro-pastoralist households, but invested heavily in re-seeding rangelands, purchasing large-scale farm machinery and building water points. The results are summarized by the World Bank as follows:

> *"Some lessons learned included: the first and perhaps main lesson incorporated in this project was the importance of linking the objectives of environmental protection and sound land use and management with tangible benefits for rural families. The project placed emphasis on managing lands for improved natural resource management and conservation which also helped to return once abandoned lands to productive use, while at the same time generating improved incomes for local stakeholders and users of the land. Though this concept of improving the environment by mitigating the threat of desertification and simultaneously improving the lives of local population is not new, cases of actual implementation were infrequent" (World Bank 2011).*

A second research priority flows from the first recommendation of inventorying the impact of projects addressing pasture degradation through rehabilitation and improvement. **What was the scientific basis for the interventions proposed and promoted to the pasture users?** We alluded above to the superficial quality of much of the current reports on pasture degradation in the countries under consideration. A more precise measurement of the quality of these reported findings is whether they rely on and refer to research results published in scientific, peer-reviewed international sources. A check through the bibliographic search engine "Web of Science" (http://wok.mimas.ac.uk/) reveals that **since the late 1980s there have been no scientific articles published with new data on pasture degradation in Tajikistan, one article on effects of deforestation on soils in Kyrgyzstan, while a very few papers with new data have been published on Kazakhstan. The same pattern is found by searching Google Scholar.**

Reading some of the reports about pasture mismanagement, degradation and the need for rehabilitation in these three countries, one soon realises that the authors are often repeating each other's assumptions and preconceptions. One of the few genuinely new field-based studies assessing the causes, effects, characteristics and implications of grazing and pasture degradation is the work now being reported by a research team from Germany and Austria (Bimüller et al. 2010). Their careful empirical measurements raise questions about any simple correlation of overgrazing and land degradation, as their results "show that soil properties strongly influence the small-scale vegetation patterns. Furthermore, they are strongly dependent on the level of grazing intensity within the different ecosystems…Grazing could therefore be examined as only one of a multitude of ecological factors influencing soil parameters" (2010:1).

Given the lack of firm data on the current processes of degradation in the Central Asian mountain ecosystems, **there is a clear need to do more in-depth field work on the multiple inter-acting causes and feedback effects of changes in the soil, vegetation, climate, and animal populations - both livestock and wildlife.** The biophysical impacts of the profound changes in land management over the past twenty years have not been adequately researched. Only when we have new reliable data will we be able to say for sure what is now causing land degradation, where and why this is occurring, where and why land is being regenerated, and eventually whether any practical measures can be taken to improve land management and still benefit the land users. Without sound data which tests the current assumptions, there is a risk that land users – farmers and pastoralists – will continue to be blamed for despoiling the land through bad management. This can provide a rationale for governments and their donor supporters to redistribute land through privatisation (as is occurring in Tajikistan) or to exclude pastoralists from their land on the basis that this helps conserve vegetation, soil, river headwaters etc. as is currently being implemented by the Chinese government in the mountainous pastoral regions neighbouring Central Asia (Harris 2010; Zhou 2011).

Institutional Orthodoxies

Another set of research priorities stems from the current policy trend to "decentralize" pasture management from the national to the local level to make it more "participatory". In Kyrgyzstan, the World Bank's current effort to establish standardised communal pasture user committees throughout the country seems to be influenced by rather simplistic ideas about homogenous "local communities" and functioning "traditional institutions". However, as in the case of the degradation discourse, these ideas have been reproduced over and over again since the collapse of the state economy. After 1991, romanticised notions invoking "nomadic traditions" have become increasingly popular, not least because they have been politically useful to the Kyrgyz government.

Empirical evidence shows, however, that nowadays agro-pastoral communities are anything but homogenous, but are instead characterised by striking disparities in terms of wealth and power (cf. Steimann 2011). Jacquesson (2010) also shows that the currently popular reliance on locally existing institutions often builds on longstanding misconceptions of "clan", "custom" and "tradition". Consequently, one would welcome **more mutual exchange between development practitioners and researchers, be it in the form of an ongoing, critical dialogue about assumptions and priorities, or a scientific monitoring of the implementation and the effects of particular development interventions.** Unfortunately, though, many development projects often operate with a much shorter time horizon than empirical research projects.

Gaps in geographical coverage

In a few regions of Kyrgyzstan and Tajikistan's mountains, there have been plenty of thorough studies on the present-day land management practices of agro-pastoralists. Certain areas have been relatively intensively researched by foreign as well as a few national researchers – for example central and north-eastern Kyrgyzstan (Naryn and Issyk Kul provinces), and the northern Pamirs of Tajikistan, on the Murghab plateau in Gorno Badakhshan, as shown by the area concentrations of studies cited in this review. The research has often been by social scientists, especially geographers, while the natural science researchers have tended to focus on land use, typically pasture management instead of irrigated or rainfed cropping, while not investigating the biophysical properties of the land and livestock. There have also been some studies of wildlife in the mountainous regions of the Pamirs of Gorno Badakhshan in Tajikistan. There have been remarkably few studies by sociologists or anthropologists on socio-cultural conditions and change in any of the mountainous regions of these countries.

While these two regions have enjoyed researchers' attention, other mountainous agro-pastoral regions of the three countries seem to have been almost completely overlooked by modern researchers. From 1998-2005 there were studies done on the transhumance of agro-pastoralists to the summer mountain pastures in south eastern Kazakhstan (Behnke 2003; Kerven 2003; Kerven et al. 2006; Coughenour et al. 2008), but since then, no other

relevant studies could be located for mountainous Kazakhstan, including the vast eastern ranges. Another important mountainous region which seems not to have attracted many researchers is southern Kyrgyzstan, specifically Batken and Osh provinces, where the climate, terrain and human culture are somewhat different than north and central Kyrgyzstan. In Tajikistan, agro-pastoralism in the central and western mountain ranges of the Surkhob and Zerafshan valleys has not been well-studied by natural and social scientists in the last two decades. **Future researchers seeking less-studied mountain sites could consider these regions of eastern Kazakhstan, southern Kyrgyzstan and central-eastern Tajikistan, where fresh information is needed.**

Lastly, we should comment on the controversial and incomplete research topics that can be discerned from this review of the literature. Though not highlighted by many reports and papers, an emerging urgent issue for mountain agro-pastoralism is the on-going process of pasture privatisation by individuals, often with explicit state and NGO support.

Since the end of the Soviet period of state collective farm land ownership, each of the countries has evolved particular sets of regulations with regards to the formal possession and use of pastures. At the same time, researchers have reported on the informal practices that accompany the changes in the legal framework and the economy, as noted in this review paper. If any general pattern can be observed, it may be that influential and wealthier villagers have the opportunity to gain more control over the more valuable pastures, arable lands and water resources. This control may be validated by formal pasture land privatisation and leasing certificates, as in the case of Tajikistan (Robinson and Whitton 2010) or be a more subtle process of land consolidation which allows exclusion of others, as reported in Kyrgyzstan (Farrington 2005; Steimann 2011) and earlier in Kazakhstan (Behnke 2003). In either case, there are winners and losers. Exclusion from formerly common property grazing areas will have a major negative impact on pastoralists' ability to provide forage for their livestock, and will also lead to further grazing pressure on the open common grazing areas that remain unprivatized. This is a process that has occurred in other parts of the world (Galvin et al. 2008). Less well-documented in the Central Asian mountain regions is the privatisation – legally or informally - of scarce irrigated arable land in the mountain valleys. This will have the same effect of excluding some villagers from a key land resource, which risks their further impoverishment. **Detailed field research is called for on the processes and effects of privatising grazing and irrigated arable land.**

The towering mountains of Central Asia hold a great appeal to certain people - amongst others - geologists, botanists, wildlife biologists, conservationists, anthropologists, hikers, bikers, eco-tourists, development workers, glaciologists, geographers, climatologists and livestock scientists. But after the researchers, development agents and tourists have come and gone, the mountain dwellers remain. They deserve a long-term commitment to understanding their problems and assisting with their efforts to find their own solutions.

ANNEX 1:

Group discussions on the background paper, June 2011

The draft version of this background paper was discussed by a set of small groups at the conclusion of the international Symposium on "Pastoralism in Central Asia: Status, Challenges and Opportunities in Mountain Areas", on 14 June 2011 in Bishkek. Seven small discussion groups each tackled one of the sub-topics in the draft Background paper. Each group was led by a discussion leader, and given one hour to meet. The groups were asked to outline the main conclusions on their particular sub-topic in the background paper, to raise any other important points not mentioned in the background paper, and to propose priorities for further research on each topic. Each discussion leader then presented their group's points, which are summarised below. In revising the Background paper, some of the comments made in the group discussions were addressed in the Climate Change section and the Degradation section.

Group 1. Arable and pasture land: a case study of Kyrgyzstan

Discussion leader: Sarah Robinson

Research Priorities:

1. Study and monitor impact of new Kyrgyz pasture law
2. Study process and impact of land market development
3. Research into methods of improving productivity of arable land
4. Research into possible connections between ethnic conflict and land access and control, particularly in southern Kyrgyzstan
5. Explore conflicts between different types of resource users on pastures (herders, state forests, mines) and look at how relationships between these different users have changed over time
6. Conduct long-term studies on pasture condition with aim of generating longitudinal data sets with control sites
7. Water use rights are also an important topic for study: including rights over water for crop irrigation and rights to water access within pastures. Links with climate change will be important here.

Across all research topics better information exchange and dissemination between researchers and policy makers is required.

Group 2. Degradation (see also discussion in section of this paper)

Discussion Leader: Yi Shaoliang

The following information was missing from the paper:

1. Extent, nature(types) and geographical distribution of rangeland degradation
2. Previous measures to mitigate pasture degradation
3. History and mechanism of pasture degradation
4. Political ecology issues
5. Link between pasture degradation and water quality
6. Russian literature should be used and referred to
7. Two or three local authors should be included in the authorship of the paper

Research priorities:

1. Resources Inventory: mapping the resources, collecting data on productivity, measuring the seasonal demands of animals, studying pasture use patterns, determining the optimal stocking rate.

2. Pasture improvement: identifying technologies/measures for pasture restoration, identifying the best plants and crops for rangeland improvement;
3. Pasture ecology: role of fires in rangelands health; nutrient recycling of pasture ecosystem; soil erosion in pasture system
4. Causes and consequences of rangeland degradations
5. How to prevent rangeland degradation.
6. Relations between pasture conditions and down-stream water qualities.

Group 4. Climate Change

Discussion leader: Elbegzaya Batjargal

Conclusions from the Background paper:

1. The information provided relies heavily on the IPCC 2007 report findings. That information is very general, and does not indicate some limitations with the existing CC models, including:
2. Conflicting scale of models used at the regional and national level projections: Global versus regional and national levels.
3. Vegetation cover models are dominated by crop cultures as wheat, whereas pasture vegetation projections do not exist.

There is a need to highlight the uncertainty of climate change impacts and state that the negative impacts negate the positive ones.

More information is needed on:

4. glaciers differentiation
5. CO^2 fertilization effect (dryland versus pasture)
6. participatory research findings
7. CO^2 fertilization function
8. permafrost and soil stability linkages
9. changes at ecosystem levels.
10. In regard to pastoralism, highlight the economics of CC impacts in terms of reduced water flow resulting in decreased crop farming and increased pastoralism.

Research Priorities:

1. Transform all the global-scale CC projections into Central Asian regional and national level models.
2. Standardization methodologies are needed for climate change data across the regional countries for easy exchange and application
3. Existing and evolving adaptation strategies
4. Connect research to on-the-ground climate change adaptation and mitigation work
5. Opportunities and constraints of facilitated mobility for key plant species
6. Long-term monitoring of pasture vegetation with a focus on the response of key forage species to climate variables
7. Economic analysis of mitigation efforts by pastoralists
8. Long term modelling of pasture mitigation efforts
9. Increase understanding of climate change impacts on:
   a. ecosystem services, i.e. pollination, water storage and filtration, and biodiversity, that support agro-pastoralism
   b. animal health and the spread of disease
10. Collaboration with the regional institutions such as the Kazakh Institute of Geography and Bangkok-based LINUS modelling and projection centres

Group 5. Governance

Discussion leader: Nargis Halimova

Conclusions from the Background paper:

1. Research has been focused more on critiques but do not offer the alternatives
2. Discussions about the Impacts of reforms are incomplete in research
3. Legal changes have happened, but services and inputs to support the changes are absent. There is nothing to replace the previous service system
4. Economic assessment of implementation of law is not considered
5. The reasons for impacts are not discussed

Research Priorities:

1. incorporation of modern technology, particular the renewable energy (solar, hydro, biogas) in the life of the herders
2. Distance learning/education for nomadic herders children
3. More attention to government initiatives regarding sustainable management of pastureland pasture use, beyond legal reforms.
4. Diversification of income sources (included in Discussion Group 7).
5. Importance of securing the pasture resources as natural common resource property and recognizing the **multiple land tenure and institutional arrangements that accommodates not only the private economic interests but also the social and ecological variability.**
6. Mechanisms of retaining the legitimate land rights of absentee land users that are not resident on their farms due to range of socioeconomic factors, such as continuous labour migration, females' marriage and movement to other districts, disabilities, motherhood, etc. Also, accessibility of transferring mechanisms particularly in the case of family members' inheritance of land use rights.
7. Mechanism for establishing feedback about implementation of the Law between the policy makers, those implement and affected people.
8. Methods and technologies for easy examination of vegetation cover of pastures

Group 6. Livestock

Discussion leader: Reginald Viktor

Trends noted in Background Paper:

1. Baseline data for transition from command to market economy
2. Changes in livestock composition
3. Kyrgyzstan reduction in sheep. Increase in goats. Lack of demand for wool. More demand for meat.
4. Fodder availability in winter limiting in both countries
5. Collapse of organizational infrastructure as impact

Research Priorities:

1. Capacity building of herders
2. Access to international market
3. Increase in fodder production (strategies and technical improvements)
4. Fiscal requirements of herders (subsidy related issue/government support)
5. Health issues of livestock and herders
6. Education of women for the craft industry
7. Improvement of herders' livelihoods.

Group 7: Incomes and Diversification

Discussion leader: Bernd Steimann

1. *How to improve value chains for agro-pastoralists? Innovative technologies? Training opportunities?*
   Agro-pastoral production may contribute much more to the livelihoods of rural producers and their households through the introduction of local processing of agro-pastoral products such as meat, wool, and milk products. Given the current lack of technologies in rural areas, research may look for simple and innovative processing technologies which can be easily implemented and applied by the rural population.

2. *Seasonality of production and marketing niche products.*
   Agro-pastoral production is subject to seasonalities, and milk products in particular are available for only a couple of months per year. Thus, also the production costs vary considerably depending on season. However, this is not necessarily an obstacle, but may also serve as a valuable marketing argument for niche products. Research may look into marketing opportunities and ways for direct marketing of agro-pastoral products (closely linked to the question of value chains raised above).

3. *Micro-finance for pastoralists.*
   Agro-pastoralists are very mobile and therefore often absent from the village. Therefore, their access to microcredits is often limited and we hypothesize that they lack the necessary information about existing credit schemes. Research may test this hypothesis by evaluating herders' need for credits, and, if necessary, may come up with new ideas on how to improve their access to microcredits.

4. *There is a need to understand cultural beliefs and barriers to product diversification.*
   Many people may hesitate to diversify their diet due to cultural reasons (hypothesis). Understanding this nexus may help to improve rural food security in future.

5. *Opportunities for ecotourism in all Central Asia, which would allow money and jobs to stay in the community.*
   In Kyrgyzstan, ecotourism has proven to offer valuable alternative/additional cash incomes for herding families, i.e. through homestays in yurts (compare Community-based tourism CBT Kyrgyzstan). The question arises how a larger share of the rural population in Kyrgyzstan and neighbouring countries may profit from CBT.

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